CHAPTER 72 - ENGINE COMPONENTS

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ENGINE NAMEPLATE INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

   A. Remove Nameplates (See Figure 201)

      NOTE: Do not remove decals or nameplates unless damage is indicated by inspection or removal is required to identify changes incorporated. When required to identify the incorporation of changes by service bulletin on the engine or power section identification plates, use steel stamp or electro-etch tool to mark applicable information in the MOD RECORD section of the identification plate.

      (1) Remove decals.

      (2) Bend tabs securing nameplates up.

      (3) Remove nameplates.

   B. Install Nameplates (See Figure 201)

      (1) Install nameplates. Bend tabs down to secure.

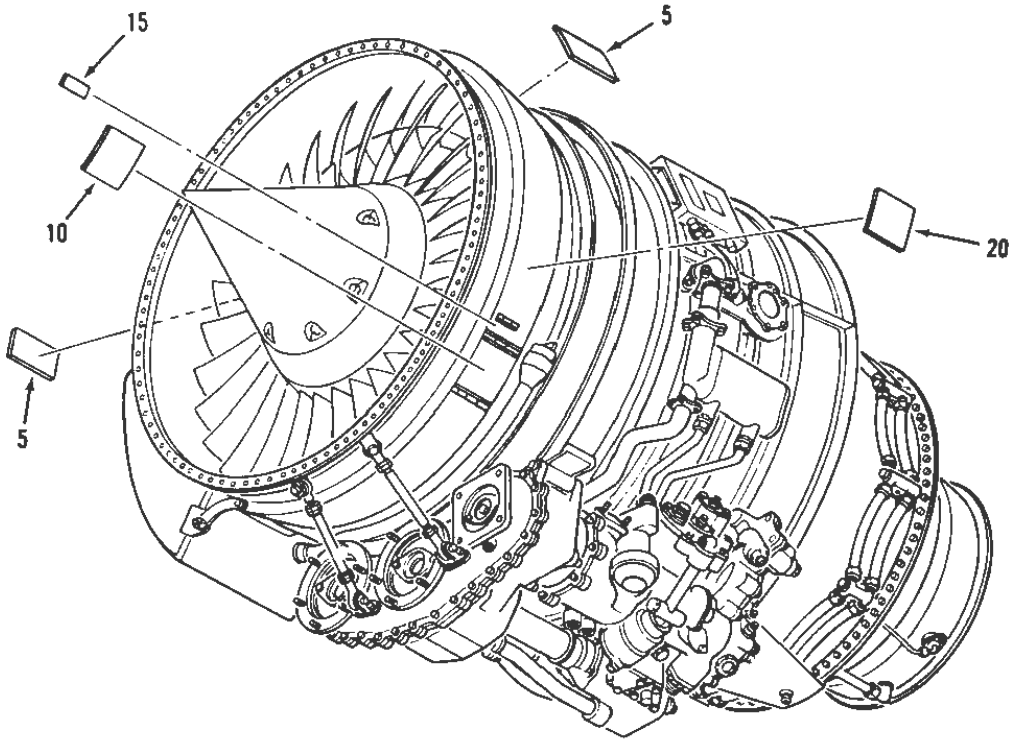
      (2) Install new adhesive-backed decals.

2. Cleaning/Painting

   A. Clean Parts

      Clean all standard metallic hardware in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method No. 1 or 2.

R



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R 5. DECAL (IPC FIG. 3)
10. IDENTIFICATION PLATE
R (ENGINE)
R

15. IDENTIFICATION PLATE (POWER SECTION)
20. CAUTION DECAL (CODES A, B POST SB72-3085)

Engine Nameplate Installation
Figure 201

ENGINE WIRING HARNESS INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

   A. (Code A) Remove Engine Wiring Harness (See Figure 201 or 202)

      (1) Disconnect harness connector P12 from computer wiring harness assembly.

      (2) Remove nuts, bolts, and clamps securing harness assembly.

      (3) (Post SB72-3044) Disconnect jumpers between connector P6 and fuel control.

      (4) Disconnect harness connectors from N2 transducer, fuel control, inlet pressure and temperature sensor, and solenoid controller valve.

      (5) Disconnect aircraft wiring from harness connector J2. Remove nuts, screws, and washers securing connector to bracket on fan inlet housing.

   B. (Codes B, C) Remove Engine Wiring Harness

      Refer to Aircraft Maintenance Manual for removal instructions.

   C. (Code A) Install Engine Wiring Harness (See Figure 201 or 202)

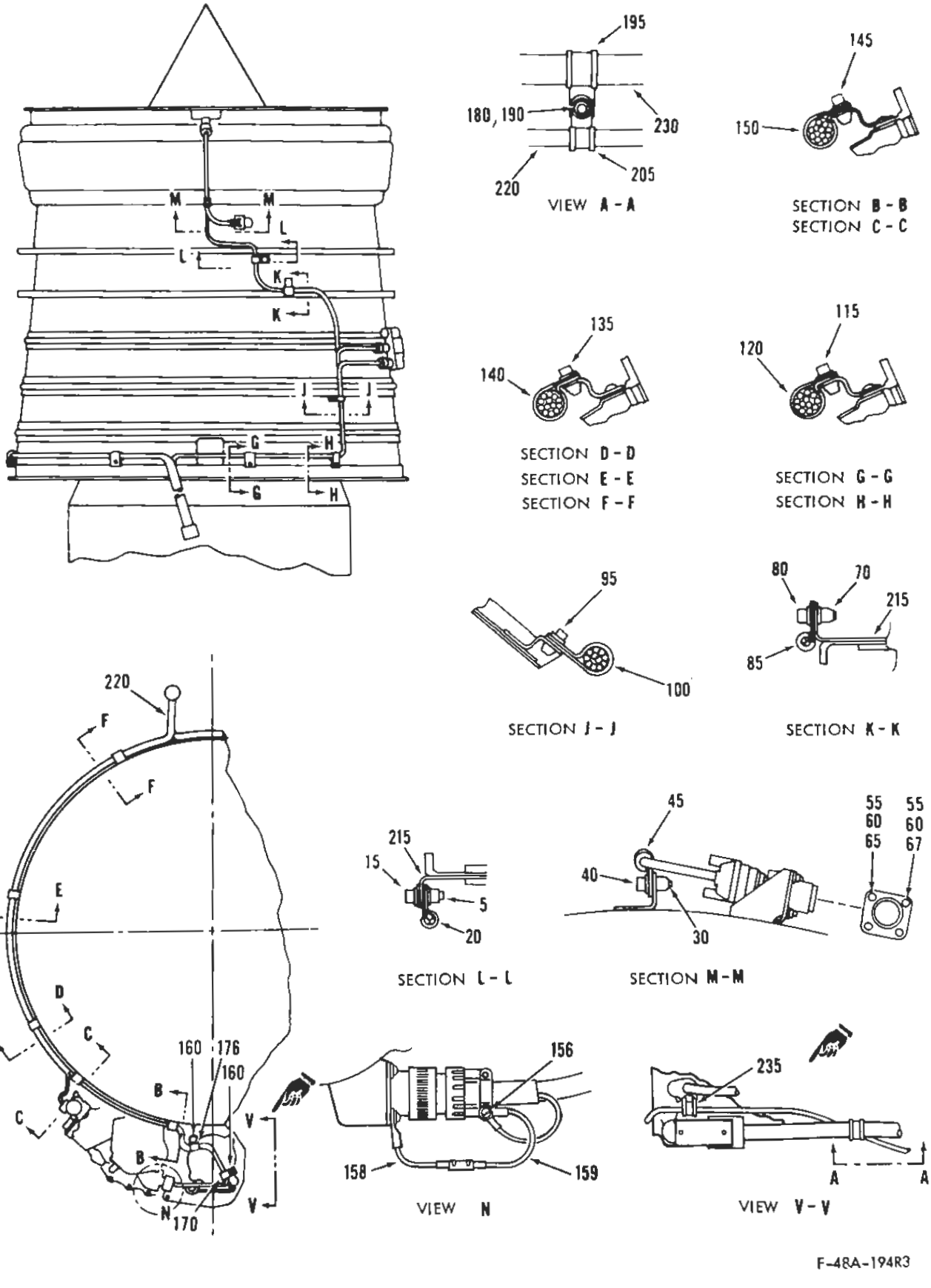
      NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

      (1) Position harness assembly on engine and connect connectors to solenoid controller valve, inlet pressure and temperature sensor, fuel control, and N2 transducer.

      (2) Tighten electrical connectors (figures 203 through 205, as applicable) to torque values as follows.

Connector P16, P17	26-32 inch-pounds
Connector P6	46-50 inch-pounds
Connector P4, P7, P8	70-75 inch-pounds
Connector P12	120-130 inch-pounds

      Tighten electrical connectors using TG65-1 through TG65-7 Strap Wrenches available from Glenair Inc, 1211 Air Way, Glendale, CA 91201.



(Code A Pre SB72-3040) Engine Wiring Harness Installation
Figure 201

1. C. (3) Install lockwire on electrical connectors in accordance with good shop practices, ensuring lockwire is tight and installed to prevent loosening rotation. Aerospace Standard AS567 (SAE) may be used as a guide for lockwire installation.

(4) Install clamps on harness and secure with bolts and nuts.

(5) (Post SB72-3044) Connect jumpers between fuel control connector P6 and fuel control.

(6) Connect harness connector P12 to computer wiring harness assembly.

(7) Secure connector J2 of harness to bracket on fan inlet housing with screws, washers, and nuts.

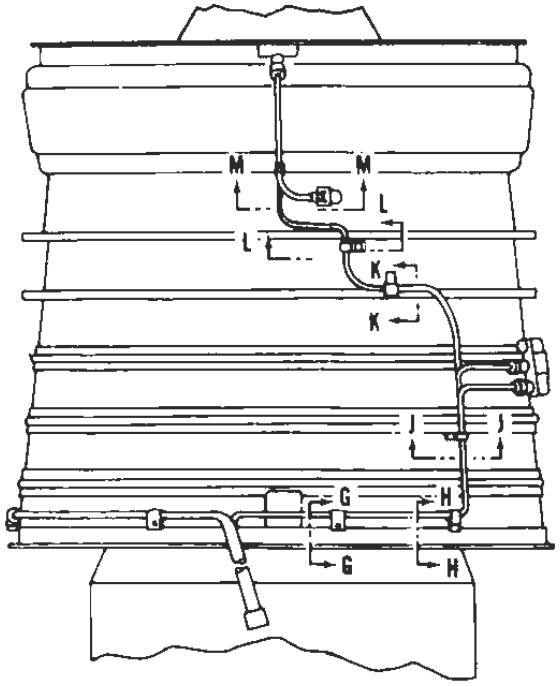
(8) Connect aircraft wiring to connector J2.

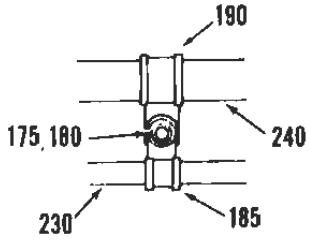
D. (Codes B, C) Istall Engine Wiring Harness

Refer to Aircraft Maintenance Manual for installation instructions.

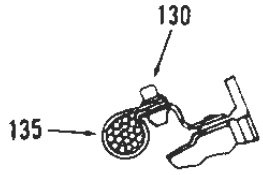
KEY TO FIGURE 201

5.	NUT (IPC FIG. 4)	135.	BOLT
15.	BOLT	140.	CLAMP
20.	CLAMP	145.	BOLT
30.	NUT	150.	CLAMP
40.	BOLT	156.	SCREW
45.	CLAMP	158.	JUMPER (POST SB72-3044)
55.	NUT	159.	JUMPER (POST SB72-3044)
60.	WASHER	160.	NUT
65.	SCREW	170.	CLAMP
67.	SCREW	176.	CLAMP
70.	NUT	180.	NUT
80.	BOLT	190.	BOLT
85.	CLAMP	195.	CLAMP
95.	BOLT	205.	CLAMP
100.	CLAMP	215.	BRACKET
115.	BOLT	220.	ENGINE WIRING HARNESS
120.	CLAMP	230.	OIL SCAVENGE TUBE
R		235.	CLAMP (PART ADDED)

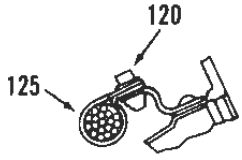




VIEW A - A



SECTION B - B
SECTION C - C



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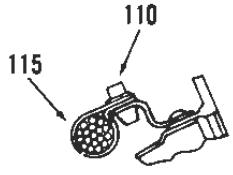

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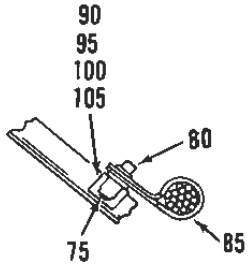
SECTION H - H



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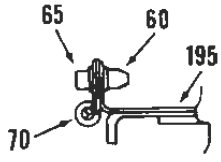

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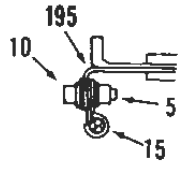

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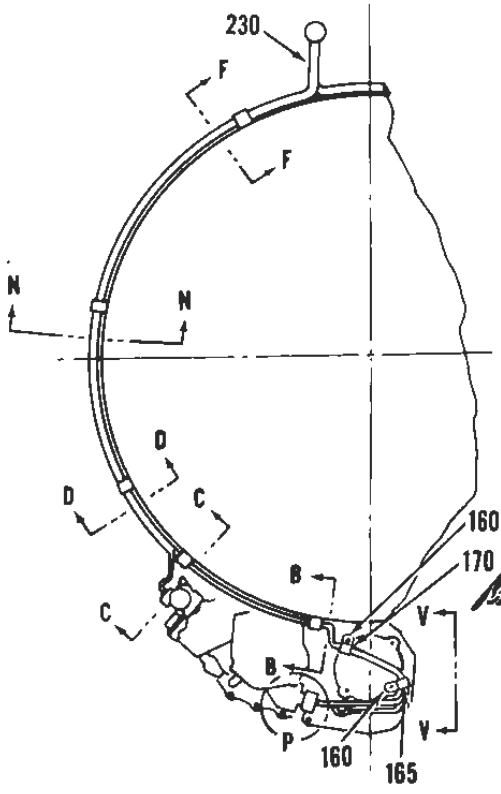

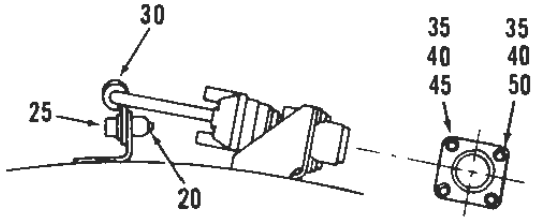

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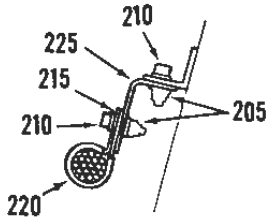

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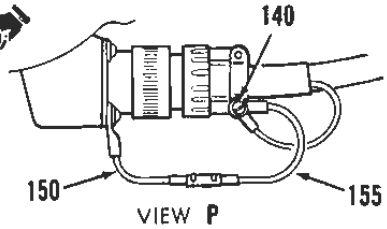
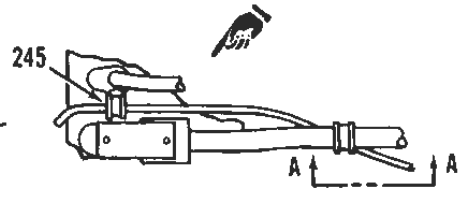


VIEW P



VIEW V - V

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2. Inspection/Check

A. (Code A) Inspect Engine Wiring Harness

(1) Inspect insulation sleeving for breaks, burns, deterioration, and loose or twisted sleeving.

(2) Inspect connectors for security, cracks, corrosion, loose or twisted wiring, bent, broken, burned or receded pins, and damaged connector threads.

KEY TO FIGURE 202

5.	NUT (IPC FIG. 5)	90.	NUT (PART ADDED)	170.	CLAMP
10.	BOLT	95.	WASHER (PART ADDED)	175.	NUT
15.	CLAMP	100.	BOLT (PART ADDED)	180.	BOLT
20.	NUT	105.	BRACKET (PART ADDED)	185.	CLAMP
25.	BOLT	110.	BOLT	190.	CLAMP
30.	CLAMP	115.	CLAMP	195.	BRACKET
35.	NUT	120.	BOLT	205.	NUT
40.	WASHER	125.	CLAMP	210.	BOLT
45.	SCREW	130.	BOLT	220.	CLAMP
50.	SCREW	135.	CLAMP	225.	BRACKET
60.	NUT	140.	SCREW	230.	ENGINE WIRING HARNESS
65.	BOLT	150.	JUMPER	240.	OIL SCAVENGE TUBE
70.	CLAMP	155.	JUMPER	245.	CLAMP (PART ADDED)
75.	NUT	160.	NUT		
R 80.	BOLT	165.	CLAMP		
R 85.	CLAMP				

2. A. (3) Inspect terminals for security or broken wires.

(4) Check wiring harness assembly for point-to-point continuity. (See figures 203 through 205, as applicable).

(5) Using multimeter set to highest resistance scale, check resistance from each connector pin to harness shielding. No deflection shall be observed except for pin connected directly to shielding (P12-R). If requirements are not met, clean electrical connectors in accordance with 3, Cleaning/Painting and repeat check.

(6) Replace wiring harness assembly if inspection requirements of steps (1) through (4) are not met.

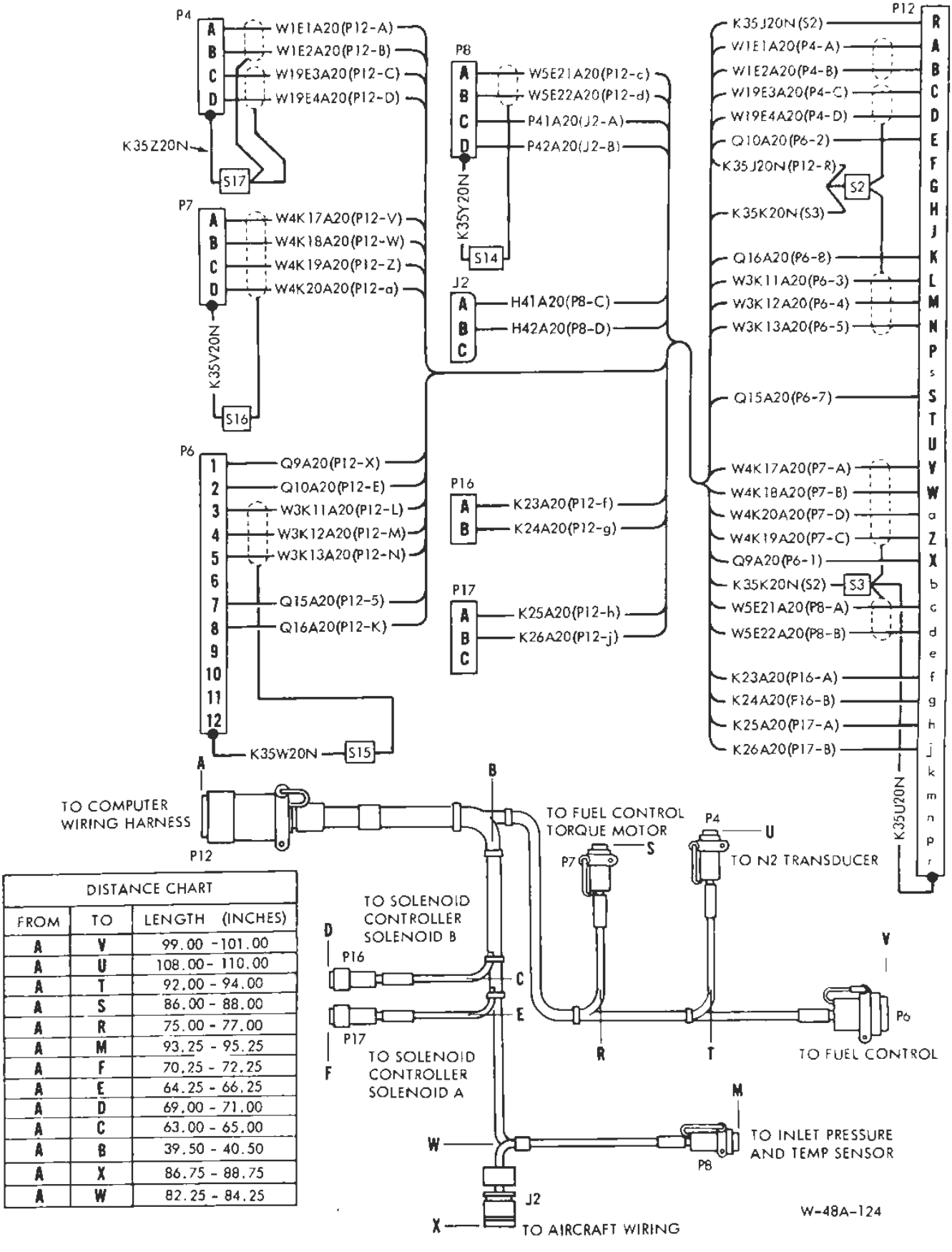
B. (Codes B, C) Inspect Engine Wiring Harness

Refer to Aircraft Maintenance Manual for inspection procedures for interconnecting wiring of engine electrical components.

3. Cleaning/Painting

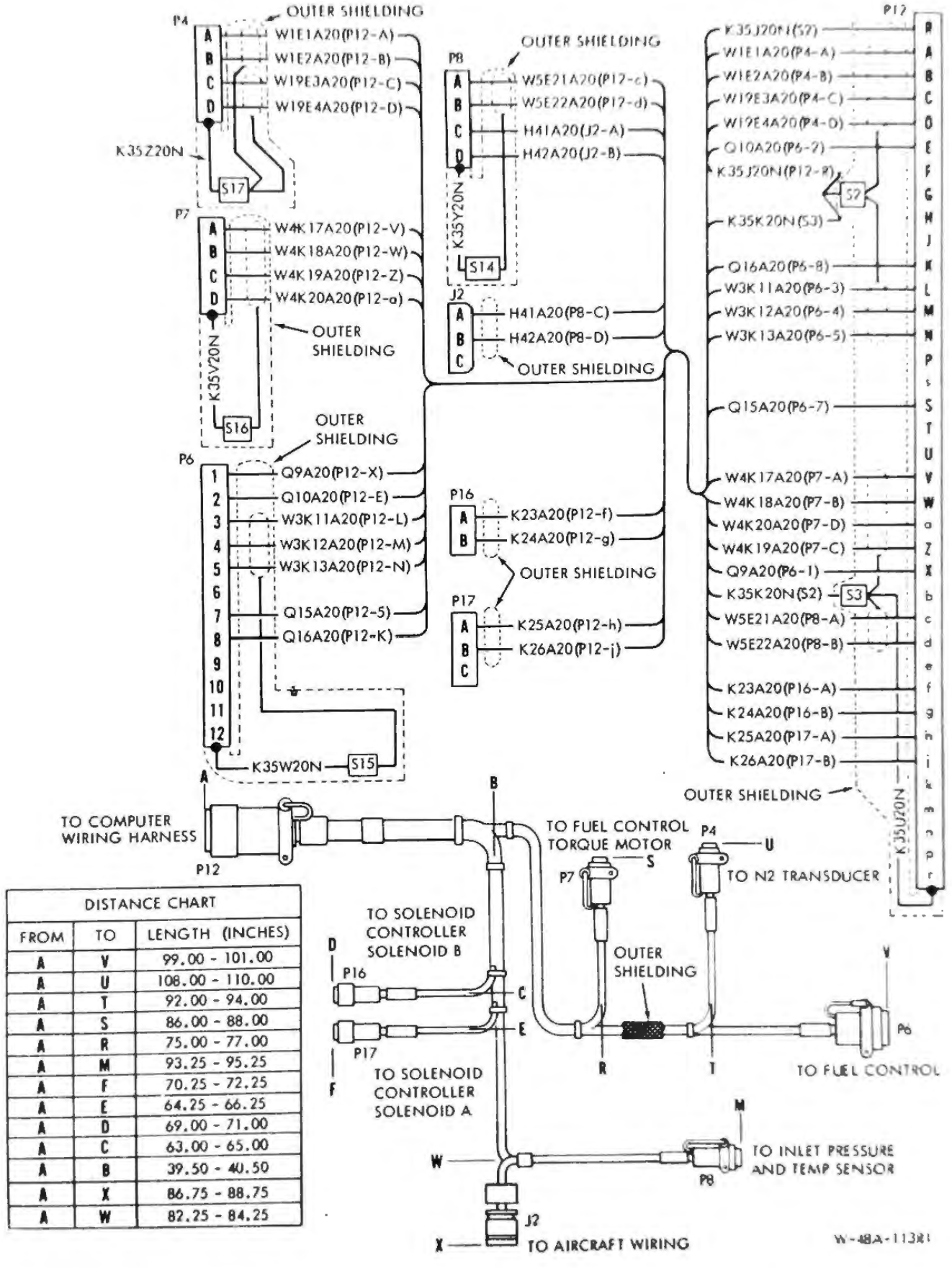
A. Clean Parts

Clean all standard metallic hardware in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method No. 1 or 2. Clean engine wiring harness in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method No. 11.



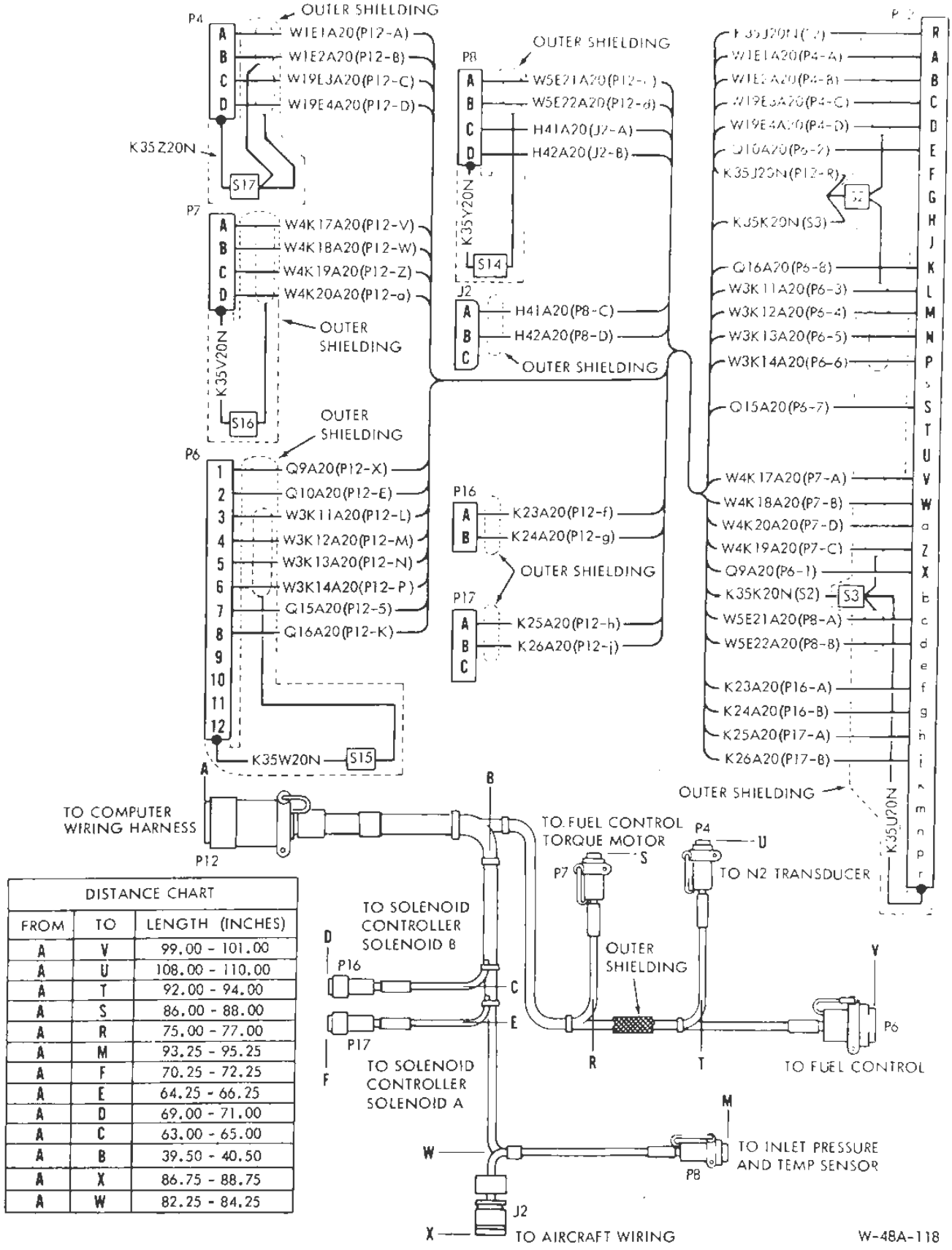
DISTANCE CHART		
FROM	TO	LENGTH (INCHES)
A	V	99.00 -101.00
A	U	108.00- 110.00
A	T	92.00 - 94.00
A	S	86.00 - 88.00
A	R	75.00 - 77.00
A	M	93.25 - 95.25
A	F	70.25 - 72.25
A	E	64.25 - 66.25
A	D	69.00 - 71.00
A	C	63.00 - 65.00
A	B	39.50 - 40.50
A	X	86.75 - 88.75
A	W	82.25 - 84.25

(Codes A Pre SB72-3013) Engine Wiring Harness
Figure 203



DISTANCE CHART		
FROM	TO	LENGTH (INCHES)
A	V	99.00 - 101.00
A	U	108.00 - 110.00
A	T	92.00 - 94.00
A	S	86.00 - 88.00
A	R	75.00 - 77.00
A	M	93.25 - 95.25
A	F	70.25 - 72.25
A	E	64.25 - 66.25
A	D	69.00 - 71.00
A	C	63.00 - 65.00
A	B	39.50 - 40.50
A	X	86.75 - 88.75
A	W	82.25 - 84.25

(Code A Post SB72-3013, Pre SB72-3051) Engine Wiring Harness
Figure 204



DISTANCE CHART		
FROM	TO	LENGTH (INCHES)
A	V	99.00 - 101.00
A	U	108.00 - 110.00
A	T	92.00 - 94.00
A	S	86.00 - 88.00
A	R	75.00 - 77.00
A	M	93.25 - 95.25
A	F	70.25 - 72.25
A	E	64.25 - 66.25
A	D	69.00 - 71.00
A	C	63.00 - 65.00
A	B	39.50 - 40.50
A	X	86.75 - 88.75
A	W	82.25 - 84.25

(Code A, Post SB72-3051) Engine Wiring Harness
Figure 205

(CODE A) FORWARD ENGINE MOUNT INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Lubricating compound (Liqui-Moly, Grade NV, Thread Compound)	Lockrey Co, Lubricants Div, Cedar Shores, Southampton, NY 11968

NOTE: Refer to the Aircraft Maintenance Manual for instructions to attach or disengage forward engine mounts from airframe mountings.

A. Remove Forward Engine Mounts from Engine (See Figure 201)

(1) Loosen all bolts securing forward engine mounts on engine two turns, then remove bolts.

(2) Remove forward engine mounts

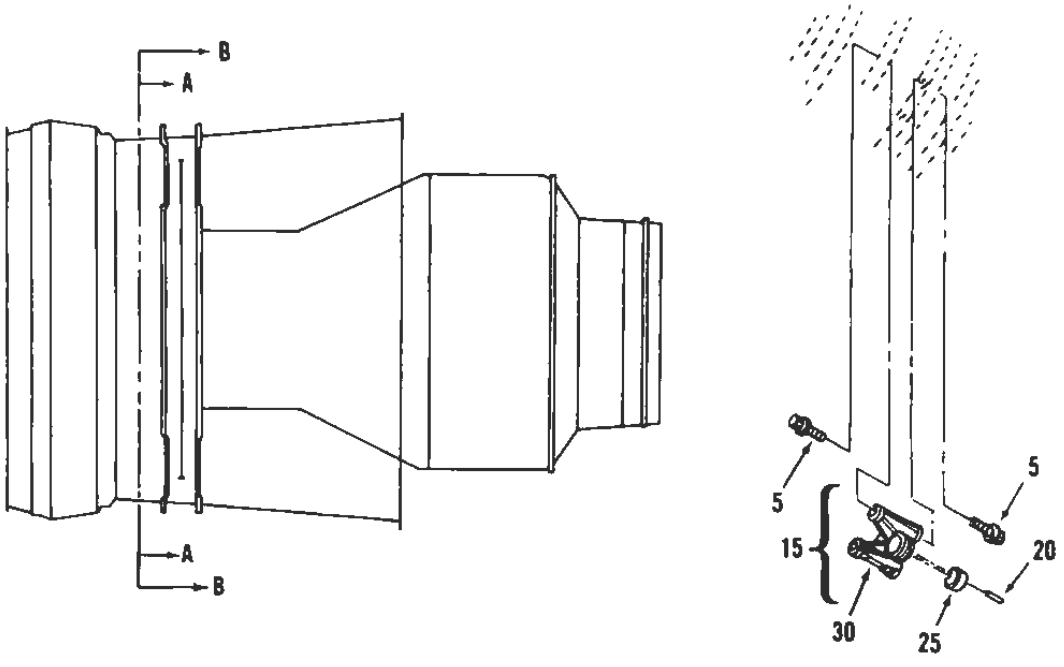
B. Install Forward Engine Mounts (See Figure 201)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Install forward engine mounts at applicable location.

(2) Coat threads of bolts with lubricating compound (Liqui-Moly, Grade NV, Thread Compound). Thread all bolts in finger-tight.

(3) Tighten bolts to torque of 350 inch-pounds.



(Code A) Forward Engine Mount Installation
Figure 201

2. Inspection/Check

A. Inspect Compontents

(1) Inspect threads of bolts and mount for galling and other damage. Replace damaged parts.

(2) Inspect bearing for freedom of rotation and excessive wear. Replace damaged parts.

3. Cleaning/Painting

A. Clean Components

Clean forward engine mounts in accordance with 72-00-00, GENERAL- CLEANING/PAINTING, Cleaning Method No. 1 or 2.

KEY TO FIGURE 201

5.	BOLT (IPC FIG. 10)	*25.	BEARING
15.	FORWARD ENGINE MOUNT	*30.	MOUNT
*20.	PIN		

*NOT DISASSEMBLED AT MAINTENANCE LEVEL

LIGHT MAINTENANCE MANUAL
TFE731-2

CHAPTER 72 - AIR INLET SECTION

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AIR INLET SECTION - DESCRIPTION AND OPERATION

1. General

The air inlet section is located directly behind the axial flow fan and guides air into the compressor section. The inlet section consists primarily of an inlet housing and a lightweight compressor inlet stator which diverts a portion of inlet air flow directly to the low pressure compressor.

FAN INLET HOUSING INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Lubricating compound (Liqui-Moly, Grade NV, Thread Compound)	Lockrey Co, Lubricants Div, Cedar Shores, Southampton, NY 11968

A. Remove Fan Inlet Housing (See Figure 201)

(1) (Code A) Disconnect engine wiring harness from inlet pressure and temperature sensor in accordance with 72-00-02, MAINTENANCE PRACTICES.

(2) Remove inlet pressure and temperature sensor components from fan inlet housing in accordance with 75-40-01, MAINTENANCE PRACTICES.

(3) Remove oil tank installation from fan inlet housing in accordance with 79-10-01, MAINTENANCE PRACTICES.

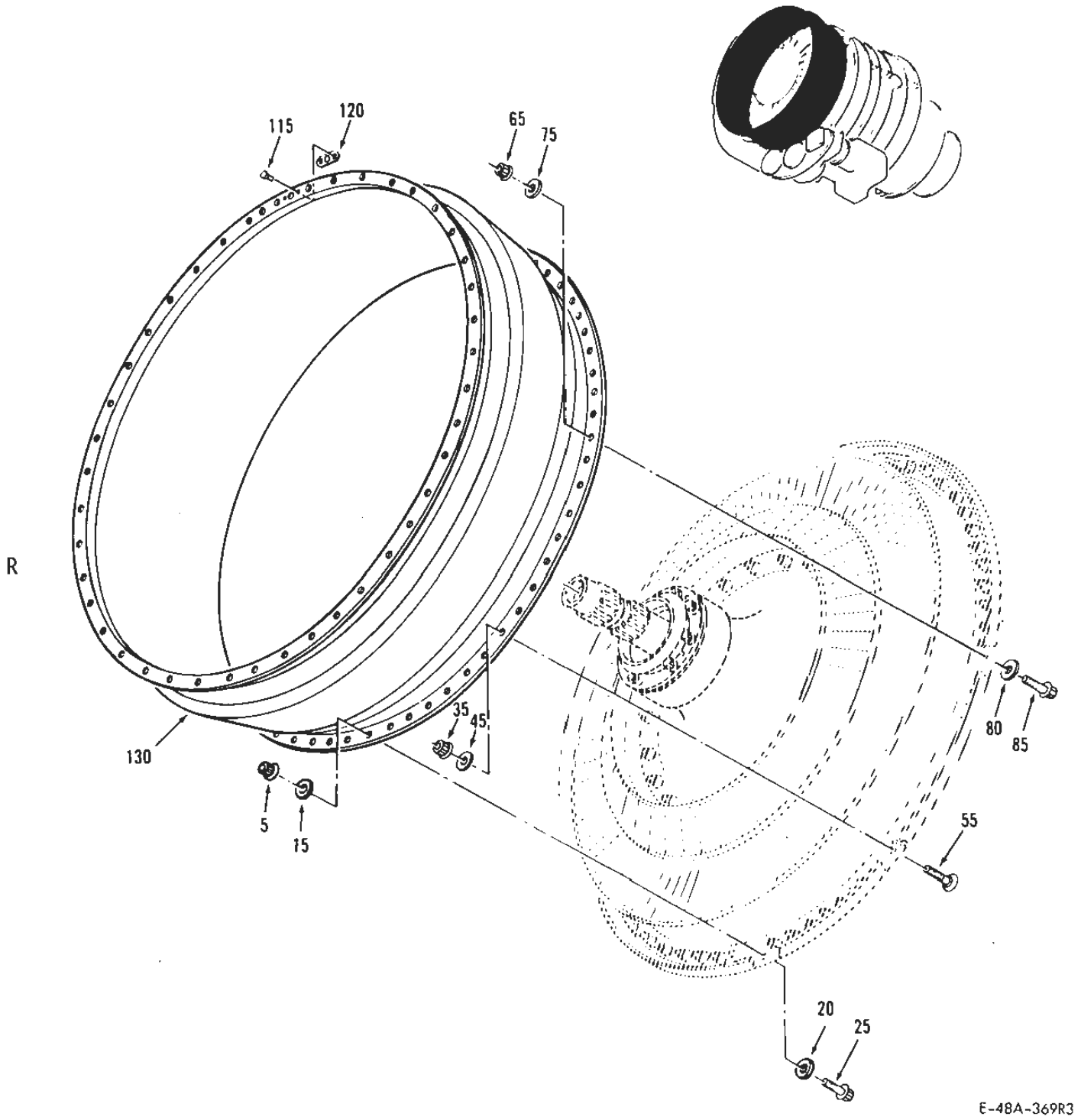
(4) Disconnect accessory and transfer gearbox installation strut assemblies from fan inlet housing in accordance with 72-60-01, MAINTENANCE PRACTICES.

R R (5) Remove fan spinner and spinner support installation in accordance with 72-70-01, MAINTENANCE PRACTICES.

(6) Remove fan rotor assembly in accordance with 72-70-03, MAINTENANCE PRACTICES.

(7) Remove nuts, washers, bolts, screws, and fan inlet housing.

R



Fan Inlet Housing Installation
Figure 201

1. B. Install Fan Inlet Housing (See Figure 201)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Install fan inlet housing on engine with inlet sensor boss at 12:00 o'clock position and mounting flange over fan by-pass stator against flange of engine support housing assembly.

(2) Coat threads of screws or bolts (85) with lubricating compound (Liqui-Moly, Grade NV, thread compound). Install screws or bolts (85) at twenty-two locations specified for screw A or bolt A, Figure 202 or bolt A, figure 203, as applicable. Install washers (75) and nuts (65) on the twenty-two screws or bolts.

(3) Install flathead screws (55) at twelve locations specified for screw C, Figure 202 or screw B, Figure 203, as applicable. Install washers (45) and nuts (35) on flathead screws.

(4) Coat threads of bolts (25) with lubricating compound (Liqui-Moly Grade NV, thread compound). Install bolts (25) in remaining twenty-six locations for bolt B, Figure 202, or bolt A, Figure 203, as applicable. Install washers (15) and nuts (5) on bolts.

(5) Tighten nuts (5, 35, 65) while holding screws or bolts to torque of 40 inch-pounds.

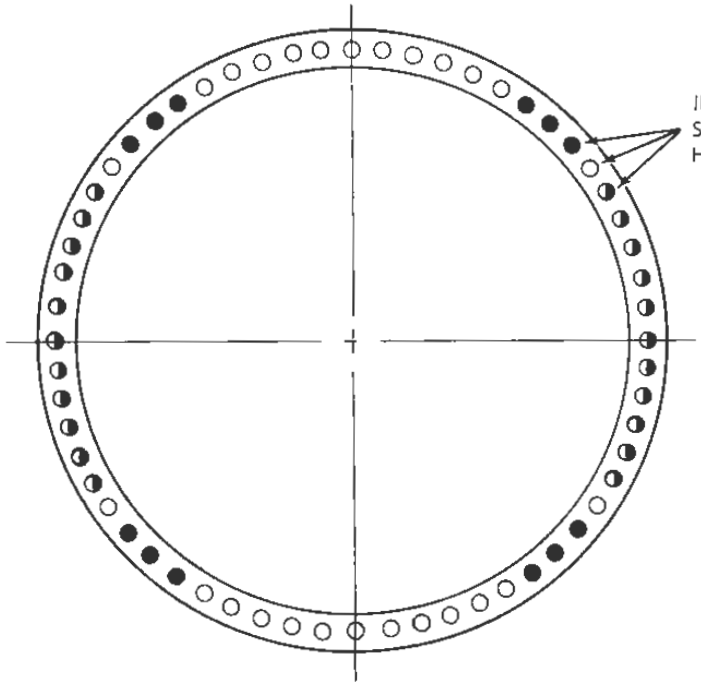
(6) Install fan rotor assembly with 72-70-03, MAINTENANCE PRACTICES.

R (7) Install fan spinner and spinner support installation in
R accordance with 72-70-01, MAINTENANCE PRACTICES.

KEY TO FIGURE 201

5. NUT (IPC FIG. 74)
15. WASHER
20. WASHER (PART DELETED)
25. BOLT
R 35. NUT
R 45. WASHER
55. SCREW
65. NUT
75. WASHER
80. WASHER (PART DELETED)
85. SCREW OR BOLT
*115. RIVET
*120. NUTPLATE
130. FAN INLET HOUSING

R *REMOVED ONLY FOR REPAIR.



NOTE:

1. VIEWED FROM AFT OF ENGINE.
2. SCREW A OR BOLT A LOCATIONS INDICATED BY SYMBOL ◑.
3. BOLT B LOCATIONS INDICATED BY SYMBOL O.
4. SCREW C LOCATIONS INDICATED BY SYMBOL ●.

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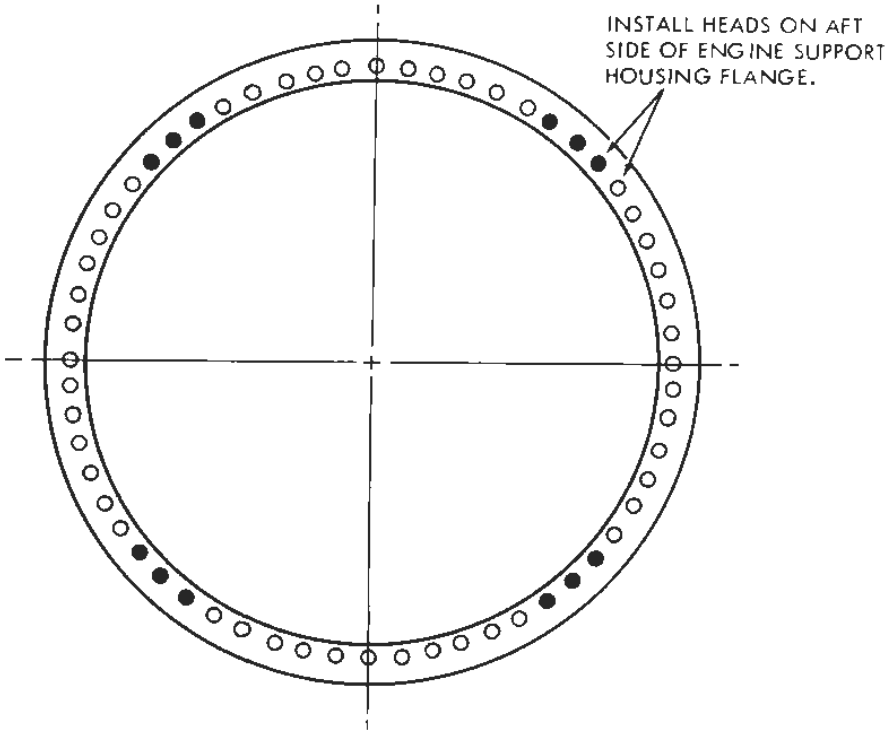
(Codes A, B) Fan Inlet Housing Attaching Hardware Locations
Figure 202



NOTE:
1. VIEWED FROM AFT OF ENGINE.
2. BOLT A LOCATION INDICATED BY SYMBOL O.
3. SCREW B LOCATION INDICATED BY SYMBOL ●.

F-48A-187

(Code C) Fan Inlet Housing
Attaching Hardware Locations
Figure 203

R 1. B. (8) Deleted.

(9) Connect accessory and transfer gearbox installation strut assemblies in accordance with 72-60-01, MAINTENANCE PRACTICES.

(10) Install oil tank installation to fan inlet housing in accordance with 79-10-01, MAINTENANCE PRACTICES.

(11) Install inlet pressure and temperature sensor components to fan inlet housing in accordance with 75-40-01, MAINTENANCE PRACTICES.

(12) (Code A) Connect engine wiring harness connector to inlet pressure and temperature sensor in accordance with 72-00-02, MAINTENANCE PRACTICES.

2. Inspection/Check

A. Inspect Fan Inlet Housing

(2) Inspect for visible cracks or evidence of structural damage.

(2) Inspect nutplates for damage. Refer to 4, Approved Repairs if damage is evident.

(3) Check for damaged acoustical material. Refer to 4, Approved Repairs if damage is evident.

(4) Replace fan inlet housing if cracks or structural damage are evident or if acoustic material is damaged beyond 4, Approved Repairs.

(5) Inspect for damaged paint. Touch up damaged paint in accordance with 3, Cleaning/Painting.

R (6) Check abradable material for nicks, scratches, or
R gouges. Nicks, scratches, or gouges which are no
R longer than three inches in length or wider than one
R inch and do not expose base metal are acceptable.
R Refer to 4, Approved Repairs for repair of nicks,
R scratches or gouges which are not within acceptable
R limits.

3. Cleaning/Painting

Table 202. Materials and Compounds

	Material or Compound	Manufacturer
	NOTE: Equivalent substitutes may be used for listed items.	
	Abrasive paper (Federal Specification P-P-101)	Commercially available
R	Color coat (A423-66 R Enamel No. 051 and R C1178 Catalyst)	Griggs Paint, Subsidiary of Domcom Dist, 3602 S 16th Place, Phoenix, AZ 85040
R	Primer (P-415-66-611B R and Catalyst C1178-66) R	Griggs Paint, Subsidiary of Domcom Dist, 3602 S 16th Place, Phoenix, AZ 85040

3. A. Clean Parts

(1) Clean all standard metallic hardware in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method No. 1 or 2.

(2) Clean fan inlet housing in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method No. 1, 2, 5, or 6.

B. Touch up Damaged Painted Surfaces

(1) Touch up bare metal on surfaces with full coat of primer (P-415-66-611B and Catalyst C1178-66) as follows.

(a) Prepare primer by mixing in equal parts by volume. Allow mixed primer to stand for 30 minutes before application.

(b) Apply one coat of primer by either brushing or spraying.

(c) Air-dry primer for 15 to 30 minutes, then heat cure with portable hot air gun for one hour at temperature not exceeding 80C (175F).

R (2) Touch up damaged color coat (A423-66 Enamel No. 051 and
R C1178 Catalyst) as follows.

(a) Remove damaged paint and blend edges of damaged paint areas with abrasive paper (Federal Specification P-P-101).

(b) Apply primer to any bare metal as specified in step (1) to thickness of one mil.

(c) Prepare color coat by mixing (Andrew Brown A423-66 Enamel No. 051 and C1178 Converter) in equal parts by volume. Allow mixed color coat to stand for 30 minutes before application.

(d) Apply one coat of color coat two to three mils thick by either brushing or spraying.

(e) Air-dry color coat for 15 to 30 minutes, then heat cure with portable hot air gun for one hour at temperature not exceeding 80C (175F).

4. Approved Repairs

Table 203. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
R Abradable coating compound R (ADX-352) R	Hysol Div, Dexter Corp, P.O. Box 312, 2850 Willow Pass Rd, Pittsburg, CA 94565
R Adhesive (EA-929) R R	Hysol Div, Dexter Corp, P.O. Box 312, 2850 Willow Pass Rd, Pittsburg, CA 94565
Potting compound (TBS-758)	General Electric Co, Silicone Products Business Dept, Waterford, NY 12188
R Toluene, technical grade R (Federal Specification R TT-T-548)	McKesson Chemical Co, 4909 W Pasadena Ave, Glendale, AZ 85301

A. Repair Damaged Acoustical (Fiber Metal and Honeycomb) Material (See Figure 204)

NOTE: Figure 204 specifies maximum allowable size for individual and accumulative repairs in allowable areas for using power-driver cutting disc. Any damaged acoustical material may be repaired within these limits. Confine the use of a power-driven cutting disc to areas specified in Figure 204 to prevent damaging the metal underlying fiber metal and honeycomb.

(1) Determine if repair can be accomplished within dimensional limits of Figure 204.

(2) Remove all loose and cracked fiber metal. Do not use power-driven cutting disc outside areas specified on Figure 204.

(3) Remove underlying honeycomb material from area below where fiber metal has been removed.

4. A. (4) Clean repair area using 1,1,1-trichloroethane (MIL-T-81533), ensuring that all surfaces of the area to be repaired are free from oil or other contamination.

(5) Mask immediate circumference of the area of repair using duct tape.

(6) Prepare potting compound (TBS-758) as directed by manufacturer.

(7) Use a small putty knife and fill the cavity with potting compound (TBS-758), forcing as much into the cavity as possible. Trowel the surface flush to fiber metal.

(8) Install duct tape over troweled potting compound (TBS-758).

(9) Apply heat to inside and outside surface of fan inlet housing, using a standard heat gun; heat for approximately ten minutes or until the potting compound (TBS-758) is cured.

(10) Remove previously installed duct tape. Remove any excess potting compound (TBS-758) from area of repair so that surface is flush with fiber metal. A slight depression is acceptable.

R B. Repair Damaged Abradable Material (See Figure 204)

R (1) Determine if repair can be accomplished within dimen-
R sional limits of Figure 204.

R (2) Clean area of repair using Toluene, (Federal Specifica-
R tion TT-T-548). Do not touch cleaned area with bare
R hands.

R 4. B. (3) If damage is through to base metal, treat exposed metal with powder (Iridite No. 14-2) as follows.

WARNING: TOUCH-UP SOLUTION IS AN ACID. USE CAUTION TO PREVENT CONTACT WITH SKIN. IF POWDER OR MIXED SOLUTION COMES IN CONTACT WITH SKIN, FLUSH OFF IMMEDIATELY WITH WATER. INHALATION OF DUST FROM THE POWDERS OR VAPORS FROM THE SOLUTION SHALL BE AVOIDED. SWABS, ETC., SATURATED WITH SOLUTION, CONSTITUTE FIRE HAZARDS IF ALLOWED TO DRY. IMMEDIATELY AFTER USE, RINSE THOROUGHLY IN TAP WATER.

(a) Mix four ounces of powder (Iridite No. 14-2) in each gallon of water used.

NOTE: Make major adjustments of pH with chromic acid, as excessive use of nitric acid will precipitate the treatment chemicals in the form of a sludge.

(b) Maintain pH of 0.9 to 1.1 using chromic acid (Federal Specification O-C-303B) and nitric acid (Federal Specification O-N-350).

(c) Maintain solution at room temperature.

(d) Allow solution to stand at least two hours before use.

(e) Apply solution to area being treated using a cotton swab or other suitable instrument. Allow treated area to remain wet for one minute. Rinse in warm tap water at 27 to 43C (80 to 110F). Air-dry using clean, dry, filtered compressed air at 20 psig maximum or oven dry for 30 minutes at 79 to 107C (175 to 225F).

R NOTE: Keep adhesive (EA-929) and abradable coating compound (ADX352) refrigerated at 6 to 11C (42 to 52F) to extend shelf life. Discard adhesive and compound that exceeds shelf life or becomes to thick to spread or handle without crumbling.

R Allow adhesive or compound to warm to room temperature or heat to a maximum of 43C (110F) prior to application. Discard excess material which has been heated for purpose of thinning.

R Clean uncured adhesive and compound from application equipment, using toluene (Federal Specification TT-T-548).

R Coating material shall be applied in such a manner as to minimize the trapping of air.

R 4. B. (4) Apply a thin coat of adhesive (EA-929), approximately 0.005 inch thick, to prepared surface, using a spatula. Coating shall have a raked surface texture prior to application of abradable coating compound.

R NOTE: Do not apply heat directly to adhesive (EA-929) when curing.

R (5) Cure adhesive at 109 to 135C (225 to 275F) for two hours, then for one additional hour at 163 to 191C (325 to 375F).

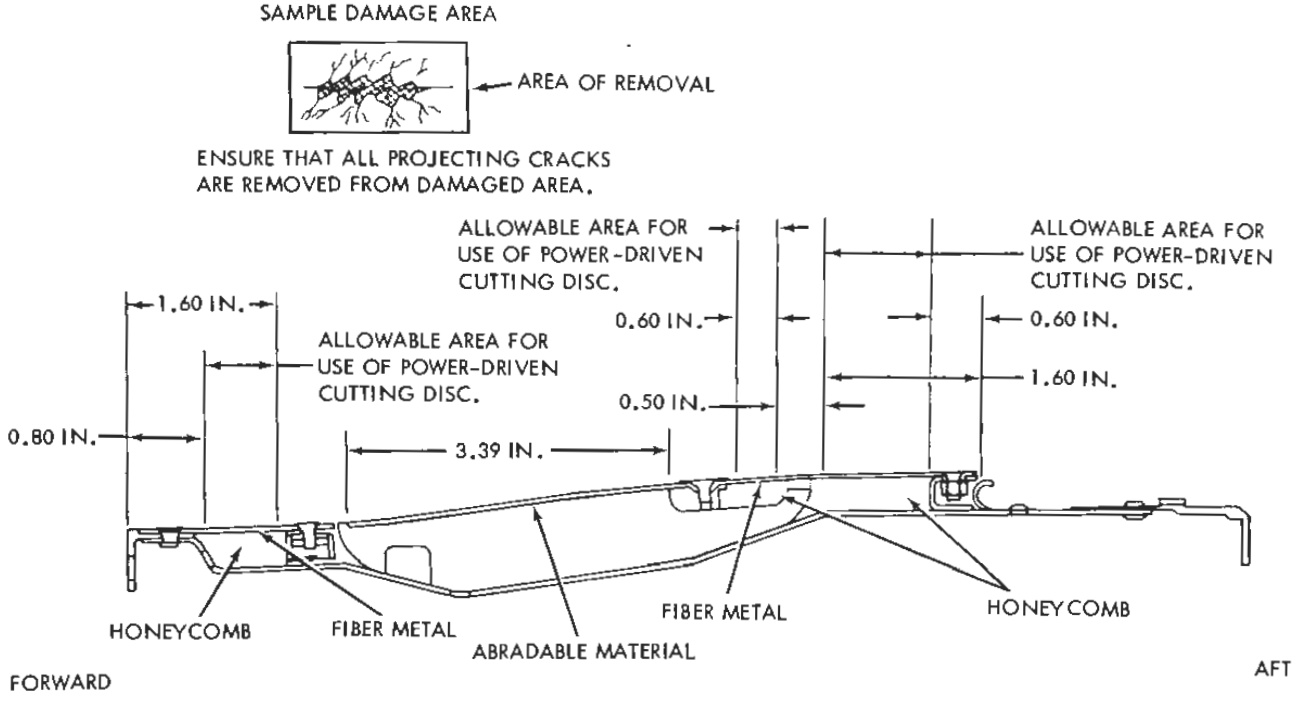
R (6) Apply a thin coat of abradable coating compound (ADX352). Contact of abradable coating to adhesive shall be ensured by lightly pressing on coating with spatula, moistened with toluene (Federal Specification TT-T-548) and smoothing it over surface at a slight angle. A slight depression to surrounding area is acceptable.

R NOTE: Do not apply heat directly to abradable coating (ADX352) when curing.

R (7) Cure abradable coating at 109 to 135C (225 to 275F) for two hours, then for one additional hour at 163 to 191C (325 to 375F).

R C. Replace Damaged Nutplates

Replace damaged nutplates on fan inlet housing in accordance with good shop practices.



MAXIMUM SURFACE AREA OF REPAIRED FIBER METAL AND HONEYCOMB AREAS FOR USE OF POWER-DRIVEN CUTTING DISC SHALL NOT EXCEED CUMULATIVE TOTAL OF 9 INCHES. MAXIMUM CIRCUMFERENTIAL LENGTH OF ANY SINGLE REPAIR SHALL NOT EXCEED 2 INCHES WITH A MINIMUM OF 1 INCH CIRCUMFERENTIAL SPACING BETWEEN REPAIRS. MAXIMUM SURFACE AREA OF REPAIRED ABRADABLE MATERIAL AREAS SHALL NOTEXCEED CUMULATIVE TOTAL OF 29.5 SQUARE INCHES.

CAUTION:

USE OF POWER-DRIVEN CUTTING DISC TO REMOVE DAMAGED MATERIAL OUTSIDE DESIGNATED AREAS MAY DAMAGE UNDERLYING METAL SURFACES. USE MANUAL TOOLS ONLY FOR REMOVAL OF DAMAGED MATERIAL IN AREAS NOT SPECIFIED FOR POWER-DRIVEN CUTTING DISC.

1-48A-295R4

R Repair of Damaged Acoustical and Abradable Material on Fan Inlet Housing
Figure 204

COMPRESSOR INLET STATOR INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Special Tools, Fixtures and Equipment

Item No.	Nomenclature	Use	Source/ Part No.
NOTE: Equivalent substitutes may be used for listed items.			
1.	Fan Core Puller	Used to remove compressor inlet stator.	293341-1

Table 202. Materials and Compounds

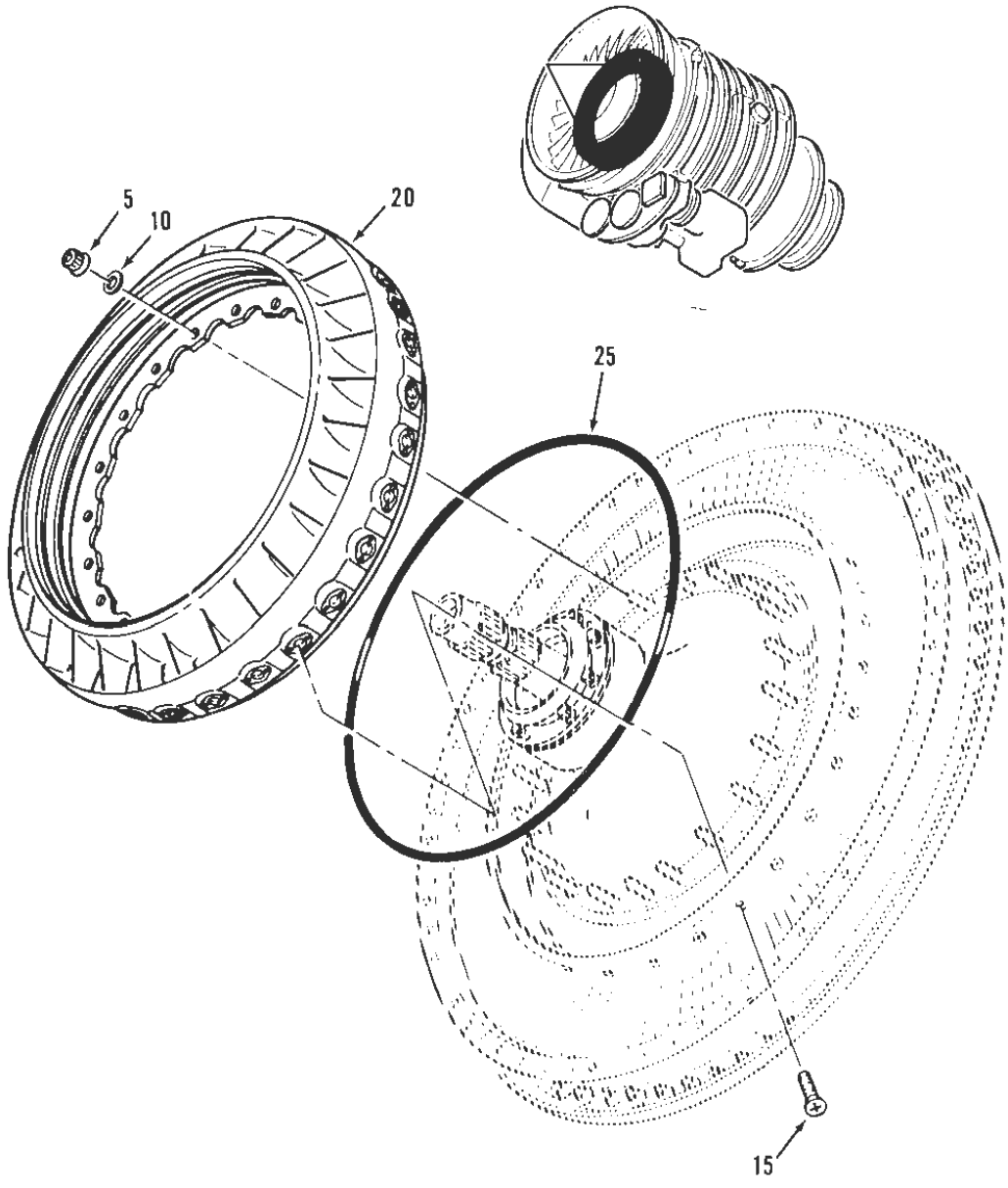
Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Lubricating compound (Liqui-Moly, Grade NV, Thread Compound)	Lockrey Co, Lubricants Div, Cedar Shores, Southampton, NY 11968

A. Remove Compressor Inlet Stator (See Figure 201)

R (1) Remove fan spinner and spinner support installation in
R accordance with 72-70-01, MAINTENANCE PRACTICES.

(2) Remove fan rotor assembly in accordance with 72-70-03, MAINTENANCE PRACTICES.

R



R 5. NUT (IPC FIG. 75)
R 10. WASHER
R 15. SCREW
20. COMPRESSOR INLET STATOR
25. PACKING

Compressor Inlet Stator Installation
Figure 201

CAUTION: AFTER NUTS AND WASHERS USED TO SECURE COMPRESSOR INLET STATOR INNER FLANGE ARE REMOVED, FAN SUPPORT ASSEMBLY (72-70-06, FIGURE 201) IS NOT RETAINED ON ENGINE AND MAY SLIDE OUT IF ENGINE IS TURNED NOSE DOWN. TEMPORARILY REINSTALL FOUR WASHERS AND NUTS ON STUDS USED AT INNER FLANGE OF COMPRESSOR INLET STATOR IF COMPRESSOR INLET STATOR IS NOT TO BE IMMEDIATELY REINSTALLED.

NOTE: All screw holes for screws removed in the following step may not be utilized due to missing nuts on compressor inlet stator. Any damage to nuts at Removal/Installation which exceeds any of the following conditions require nut replacement in accordance with 4, Approved Repairs.

(1) More than five nuts missing or inoperative.

(2) Less than two operative nuts to either side of a single missing or inoperative nut.

(3) Less than three operative nuts to either side of two adjacent missing or inoperative nuts.

(4) More than two adjacent missing or inoperative nuts in any 90-degree segment of screw circle.

R 1. A. (3) Remove nuts, washers, screws, compressor inlet stator, and packing. If unable to pull out compressor inlet stator manually, use 293341-1 puller to remove.

B. Install Compressor Inlet Stator (See figure 201)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Install new packing in groove on intermediate case assembly.

(2) If previously installed, remove four nuts and washers used to temporarily retain fan support assembly (72-70-06, figure 201).

1. B. (3) Coat threads of studs in compressor housing which attach compressor inlet stator with light coat of lubricating compound (Liqui-Moly, Grade NV, thread compound). Position compressor inlet stator over packing and the studs in compressor case.

NOTE: All nuts for screws installed in the following step may not be present. Any damage at Removal/Installation to nuts exceeding any of the following conditions requires nut replacement in accordance with 4, Approved Repairs.

(1) More than five nuts missing or inoperative.

(2) Less than two operative nuts to either side of a single missing or inoperative nut.

(3) Less than three operative nuts to either side of two adjacent missing or inoperative nuts.

(4) More than two adjacent missing or inoperative nuts in any 90-degree segment of screw circle.

R R (4) Install nuts, washers, and screws. Tighten nuts (5) to torque of 365 inch-pounds. Tighten screws (15) to torque of 40 inch-pounds.

(5) Install fan rotor assembly in accordance with 72-70-03, MAINTENANCE PRACTICES.

R R (6) Install fan spinner and spinner support installation in accordance with 72-70-01, MAINTENANCE PRACTICES.

2. Inspection/Check

A. Perform Visual Inspection of Compressor Inlet Stator

(1) Visually inspect stator. Cracks and broken welds shall be cause for replacement. Replace damaged nuts on outer diameter of stator in accordance with 4, Approved Repairs.

(2) Visually inspect vane surfaces for deformation. Dents not exceeding a depth of 0.100 inch are acceptable for

dents not within 0.100 inch of vane inner or outer base. Dents not exceeding depth of 0.050 inch within 0.100 inch of vane inner or outer base are acceptable providing no deformation is caused on opposite side of vane.

2. A. (3) Visually inspect vane surfaces for nicks. Nicks shall be cause for replacement.

3. Cleaning/Painting

Table 203. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Methyl-ethyl-ketone (MEK) (Federal Specification TT-M-261)	Commercially available

3. A. Clean Parts

(1) Clean all standard metallic hardware in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method No. 1 or 2.

(2) Clean compressor inlet stator.

(a) Wipe stator with methyl-ethyl-ketone (MEK) (Federal Specification TT-M-261).

(b) Immerse stator in alkaline cleaner solution (Diversey 909) specified in 72-00-00, GENERAL - CLEANING/PAINTING for two to four minutes and brush as required.

(c) Rinse stator in warm tap water at 27 to 43C (80 to 110F), then dry with clean compressed air.

4. Approved Repairs

Table 204. Special Tools, Fixtures and Equipment

Item No.	Nomenclature	Use	Source/ Part No.
NOTE: Equivalent substitutes may be used for listed items.			
1.	Stator Expander	Expands ring retainer of stator for welding	294154-1

Table 205. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Liquid detergent (household dish soap)	Commercially available
R Primer (P-415-66-611B R and Catalyst C1178-66) R	Griggs Paint, Subsidiary of Domcom Dist, 3602 S 16th Place, Phoenix, AZ 85040

A. Replace Vanes (See Figure 202)

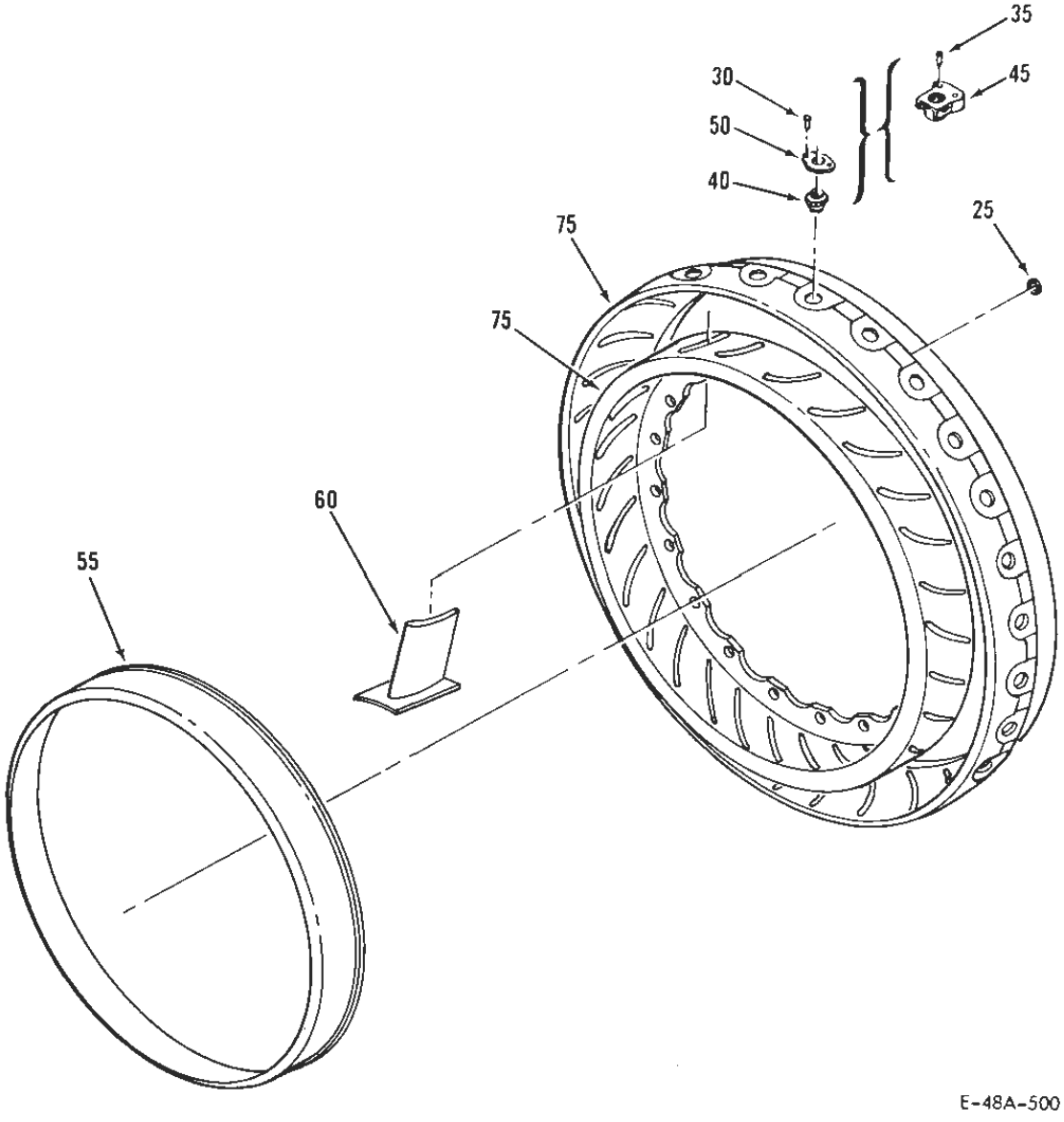
(1) Grind off spot welds securing end of ring retainer.

(2) Disengage flange on ring retainer from inner portion of stator and remove ring retainer to allow removal of stator vanes.

(3) Slide vanes to be replaced inward to disengage stator and remove vanes.

(4) Wet outer end and airfoil surfaces of replacement vanes with liquid detergent to aid installation, and install replacement vanes on stator.

(5) Expand ring retainer within inner portion of stator to secure vanes in place using 294154-1 expander. Install expander so split line of tool provides clearance for spot welding end of ring retainer.



R 25. SEAL (IPC FIG. 76)
R 30. RIVET
R 35. RIVET
R 40. NUT
R 45. NUT
50. NUTPLATE RETAINER
55. RING RETAINER
60. STATOR VANE
75. STATOR

Compressor Inlet Stator
Figure 202

4. A. (6) Spot weld end of ring retainer at points of original welds to secure in expanded position.

(7) Remove 294154-1 expander.

B. Replace Missing or Defective Nuts (40), Rivets (30), or Retainer (50), on Outer Diameter of Stator (See Figure 202)

(1) Drill out two rivets securing retainer for missing or defective nut. Remove retainer. Remove any remaining pieces of rivet or chips from inside stator.

(2) Machine to just remove defective nut from retainer.

(3) Install new nut in retainer and tack-weld to retainer where nut surface recedes below contour of retainer.

(4) Install retainer with new nut, then rivet in place in accordance with good shop practices.

R (5) Prepare primer (P-415-66-611B and Catalyst C1178-66) by mixing ingredients in equal parts by volume. Apply a thin, even coat of primer with swab to outer surface of retainer and nut. Allow primer to air-dry for 15 to 30 minutes, then heat-cure for one hour at 79 to 107C (175 to 225F).

C. Replace Missing or Defective Nuts (45), or Rivet (35) on Outer Diameter of Stator (See Figure 202)

(1) Drill out two rivets securing missing or defective nut. Remove nut. Remove any remaining pieces of rivet or chips from inside stator.

(2) Install nut, then rivet in place in accordance with good shop practices.

CHAPTER 72 - COMPRESSOR SECTION

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COMPRESSOR SECTION - DESCRIPTION AND OPERATION

1. General

The compressor section of the engine consists essentially of those components located in the center of the engine and enclosed by the compressor case and compressor housing. The principal components of the compressor section are an axial four-stage low pressure compressor assembly and a centrifugal single-stage high pressure compressor. The high pressure and low pressure compressors are mounted on separate concentric shafts with the low pressure shaft passing through the interior of the high pressure shaft.

Inlet air enters the low pressure compressor where it is compressed and directed through an inter-compressor case to the high pressure compressor. Air is further compressed by the high pressure compressor and is discharged into the combustion section. The low pressure compressor is supported at the forward end by a ball bearing with a carbon seal to prevent oil flow to the compressor, and at the aft end by a roller bearing. A borescope inspection port is provided through the engine support housing and the intermediate case assembly just forward of the first stage compressor rotor assembly to allow inspection of the rotor assembly blades. The port is closed by a plug during engine operation.

LOW PRESSURE COMPRESSOR BEARING AND NO. 3 SEAL INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Grease (Acryloid HF-825 or HF-827)	Rohm and Haas Co, Independence Mall W, Philadelphia, PA 19105
Lubricating compound (Liqui-Moly, Grade NV, thread compound)	Lockrey Co, Lubricants Div, Cedar Shores, Southampton, NY 11968
Methyl-ethyl-ketone (MEK) (Federal Specification TT-M-261)	Commercially available

Table 202. Special Tools, Fixtures and Equipment

Item No.	Nomenclature	Use	Source/ Part No.
NOTE: Equivalent substitutes may be used for listed items.			
1.	Seal Installing Driver	Used to install seal.	294593-1
2.	Mechanical Puller Set	Used to remove retainer.	289767-1
3.	Mechanical Puller Set Pilot (part of 289767-1)	Used to remove retainer.	289767-15
4.	Mechanical Puller	Used to remove bearing.	289774-1
5.	Torque Wrench Adapter	Used to remove nut.	289777-1

Table 202. Special Tools, Fixtures and Equipment (Cont)

Item No.	Nomenclature	Use	Part No.
NOTE:	Equivalent substitutes may be used for listed items		
6.	Mechanical Puller	Used to install bearing.	289785-1
7.	Adapter Retainer	Used to remove nut.	291272-1
8.	Mechanical Seal Puller	Removes stationary oil seal.	294472-1

1. A. Remove Ball Bearing (See Figure 201)

R R (1) Remove fan spinner and spinner support installation in accordance with 72-70-01, MAINTENANCE PRACTICES.

(2) Remove fan rotor assembly in accordance with 72-70-03, MAINTENANCE PRACTICES.

(3) Remove compressor inlet stator in accordance with 72-20-02, MAINTENANCE PRACTICES.

(4) Remove fan support assembly in accordance with 72-70-06, MAINTENANCE PRACTICES.

R R R (5) Remove anti-ice seal and seal support/lubricating nozzle and nozzle support in accordance with 72-72-01, MAINTENANCE PRACTICES.

R (6) Remove pinion, planet gear, and coupling shaft installation in accordance with 72-72-02, MAINTENANCE PRACTICES.

(7) Straighten tabs on nut retainer. Remove bolt, nut retainer, and washer. Install 289777-1 adapter and 291272-1 retainer, then remove nut. Nut has left-hand threads.

(8) Using 289767-1 puller set with 289767-15 puller set pilot, remove shaft retainer.

(9) Using 289774-1 puller, remove forward half of inner race of bearing. Remove outer race of bearing. Using 289774-1 puller, remove aft half of inner race of bearing.

1. B. Remove No. 3 Seal (See Figure 202)

(1) Remove ball bearing in accordance with paragraph 1.A.

(2) Remove spacer, spring washer, rotor, and shims. Record number and thickness of shims.

(3) Remove retaining ring.

CAUTION: WHEN PERFORMING THE FOLLOWING STEP, HANDLE SEAL WITH CARE TO AVOID INADVERTANT DISASSEMBLY. SEAL IS PRESSURE CHECKED AS A UNIT AND SHOULD NOT BE DISASSEMBLED IF SEAL TO BE REUSED. SEAL COMPONENTS ARE EASILY DAMAGED BY HANDLING.

(4) Remove No. 3 seal using 294472-1 puller as follows.

R (a) Install pinned (inner/outer) guide sleeves of puller over shaft (in bore of seal) so three lobes at end of inner guide sleeve can enter bore of seal housing. Lift on shaft in bore of seal and push inner guide sleeve aft to seat inner guide sleeve on shaft shoulder. (When seated, inner guide sleeve centers shaft within inside diameter of seal.)

R (b) Position outer guide sleeve fully forward (away from seal) against stop ins of guide sleeves.

R (c) Remove clevis pin securing one of three legs of uninstalled portion of puller and remove leg.

R (d) Install two remaining legs of puller over guide sleeves and into inside diameter of seal housing (between lobes on inner guide sleeve) so flanges on leg ends engage shoulder at inside diameter of seal housing.

R (e) Install previously removed leg of puller in remaining gap between inner guide sleeve lobes and engaging flange on leg end on shoulder of seal housing. Align clevis pin hole of leg with mating holes in yoke of puller and secure with previously removed clevis pin.

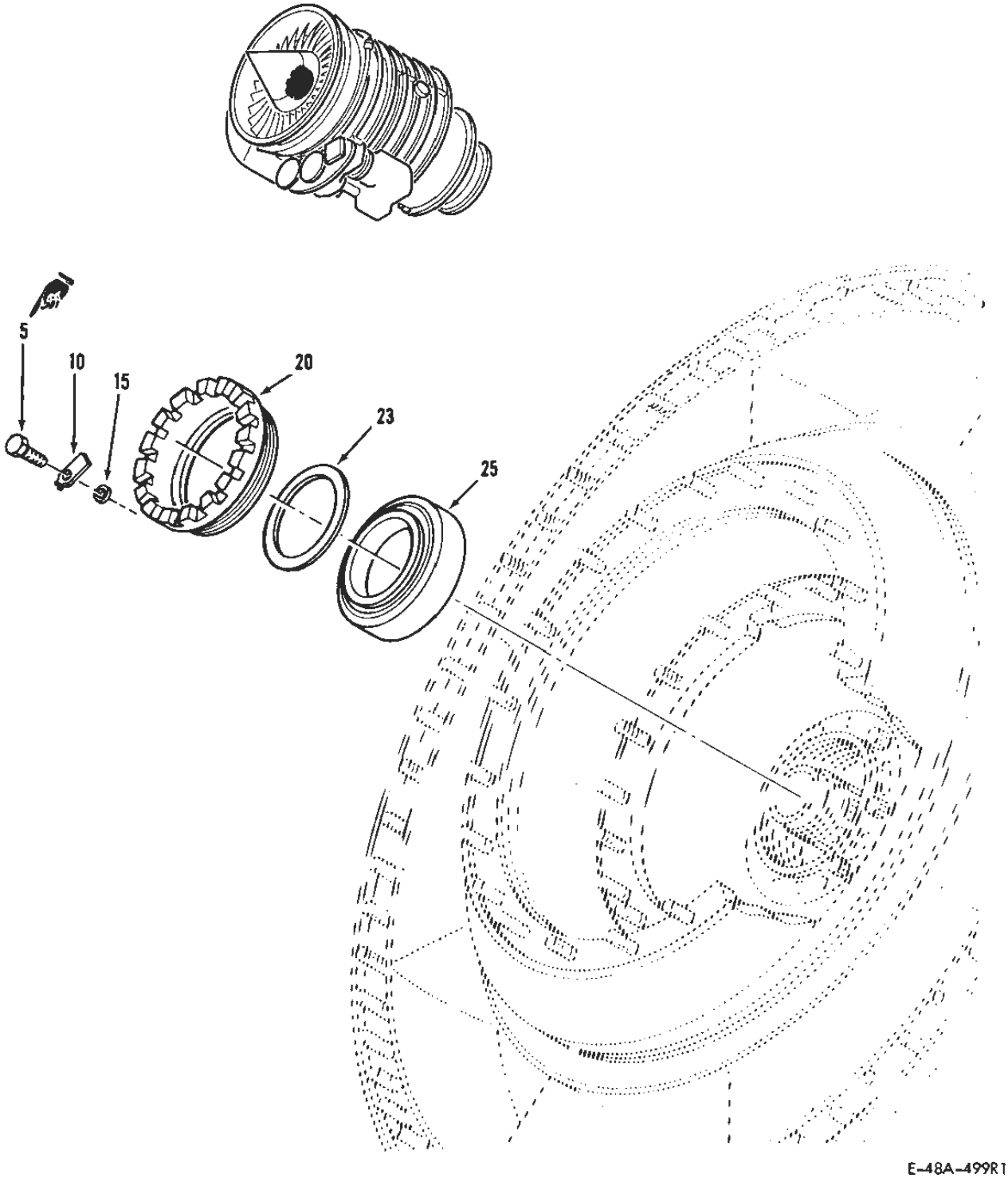
R (f) With three legs of puller engaged on shoulder of seal housing, slide outer sleeve guide toward seal housing to lock legs of puller outboard.

R (g) Tighten jam nut of puller against ends of puller legs at yoke.

R 1. B. (4) (h) Use sliding hammer function of puller to lightly
R impact seal housing forward and remove seal from
R engine.

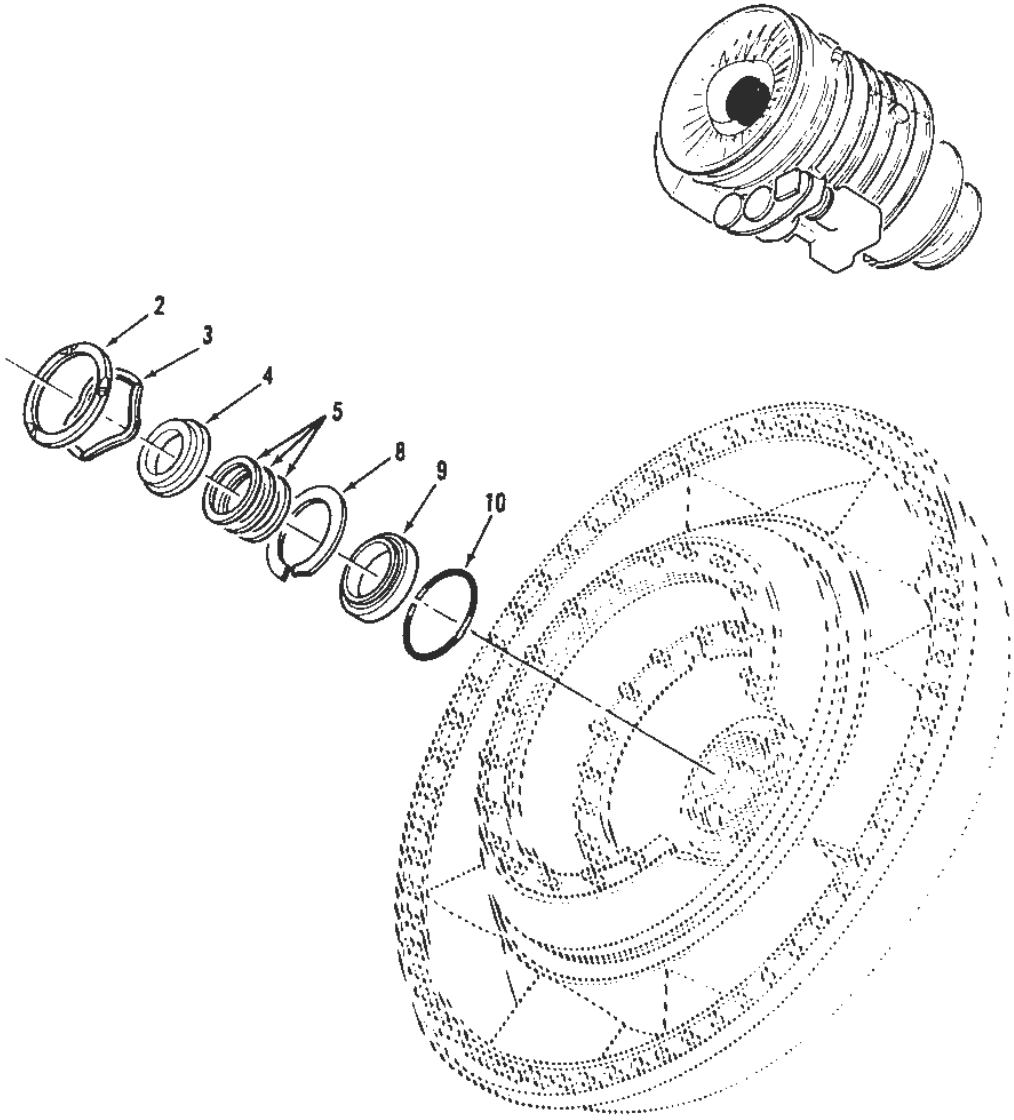
R (i) Remove puller from seal.

(5) Remove packing. (See figure 202.)



5. BOLT (IPC FIG. 90)
10. NUT RETAINER
15. WASHER
20. NUT
23. SHAFT RETAINER
25. BALL BEARING

Low Pressure Compressor Bearing Installation
Figure 201



2. SPACER (IPC FIG. 91)
3. SPRING WASHER
4. ROTOR
5. SHIM
8. RETAINING RING (IPC FIG. 116)
9. NO. 3 SEAL
10. PACKING

Low Pressure Compressor No. 3 Seal Installation
Figure 202

1. C. Install No. 3 Seal (See Figure 202)

(1) When ball bearing or nut (figure 201) or rotor (figure 202) is to be replaced, it may require adjustment of shim (figure 202) thickness to maintain required dimensions. Determine if shim thickness adjustment is required as follows.

(a) Measure thickness of part being replaced (ball bearing or nut (figure 201) or rotor (figure 202)) as follows. Record as Dimension A.

R 1) Measure thickness of bearing across outer
R race.

R 2) Measure thickness of rotor on inner diameter.

R 3) Measure dimension of nut from shouldered
R flange seating surface across threads to end
R of nut.

(b) Measure thickness of replacement part. Record as Dimension B.

(c) Subtract Dimension B from Dimension A. If result if positive (replacement part dimension smaller), shims must be changed to increase total shim thickness by amount of result (to nearest 0.001 inch). If result is negative (replacement part dimension greater), shims must be changed to decrease total shim thickness by amount of result (to nearest 0.001 inch).

(2) Install packing in groove.

(3) Apply engine oil to housing of No. 3 seal and install seal using 294593-1 driver. Ensure seal is fully seated, then install retaining ring. Verify that retaining ring is in groove. (See figure 202).

WARNING: METHYL-ETHYL-KETONE (MEK) IS TOXIC AND FLAMMABLE. USE IN WELL-VENTILATED AREA. AVOID BREATHING FUMES OR CONTACT WITH SKIN TO PREVENT DAMAGE TO PHYSICAL HEALTH. WEAR PROTECTIVE CLOTHING. KEEP CONTAINERS CLOSED WHEN NOT IN USE, KEEP AWAY FROM SOURCES OF HEAT, FLAME, OR SPARKS TO AVOID FIRE HAZARD.

(4) If new ball bearing or nut (figure 201) or rotor (figure 202) is to be installed, install thickness of shims calculated in step (1). If original ball bearing

removed at removal. Wipe face of rotor with methyl-ethyl-ketone (MEK) (Federal Specification TT-M-261) and install rotor on shaft.

1. C. (5) Install spring washer and spacer in housing. Ensure spring washer and spacer are properly seated. Grease (Acryloid HF-825 or HF-827) may be applied to spring washer and spacer to assist in maintaining proper seating.

1. D. Install Ball Bearing (See Figure 201)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Install No. 3 seal components in accordance with paragraph 1.C.

NOTE: If ball bearing or nut is replaced, thickness of compressor seal shims (figure 202) used may require adjustment. Refer to paragaph 1.C.

(2) Ensure spring washer and spacer (figure 202) are properly seated. Coat threads and face of nut (figure 201) with lubricating compound (Liqui-Moly, Grade NV, thread compound). Orient components of bearing so vender markings face puller (forward) when installed. Press aft half of bearing inner race onto shaft using 289785-1 puller. Place outer race, cage, and balls on aft half of bearing inner race. Install nut hand tight to ensure bearing outer race is maintained in proper position. (Nut has left-hand threads.) Using 289785-1 puller, press forward half of bearing inner race onto shaft. Install shaft retainer. If necessary, heat shaft retainer with propane torch to allow installation. Ensure shaft retainer is not overheated.

(3) Using 289777-1 adapter and 291272-1 retainer, tighten nut (20) to a torque of 1500 to 2500 inch-pounds. (Nut has left-hand threads.)

(4) If slot on nut is not aligned with previous position of nut retainer, select another bolt hole for nut retainer which is aligned and interchange bolt and washer at selected position with previously used location for bolt and nut retainer. Install bolt and new nut retainer. Tighten bolt (5) for nut retainer and any other bolts loosened on bolt circle for nut retainer to torque of 60 inch-pounds. Bend tabs at bolt against bolt flats to lock position.

(5) Install pinion, planet gear, and coupling shaft installation in accordance with 72-72-02, MAINTENTANCE PRACTICES. R

R 1. D. (6) Install anti-ice seal and seal support/lubricating
R nozzle and nozzle support in accordance with 72-72-01, MAINTENANCE PRACTICES.

(7) Install fan support assembly in accordance with 72-70-06, MAINTENANCE PRACTICES.

(8) Install compressor inlet stator in accordance with 72-20-02, MAINTENANCE PRACTICES.

(9) Install fan rotor assembly in accordance with 72-70-03, MAINTENANCE PRACTICES.

R (10) Install fan spinner and spinner support installation in
R accordance with 72-70-01, MAINTENANCE PRACTICES.

2. Inspection/Check

A. Inspection Ball Bearing (See Figure 201)

Inspect ball bearing in accordance with 70-00-00, 7, Bearing Handling and Inspection.

B. Inspect No. 3 Seal (See Figure 202)

(1) Inspect carbon ring sealing surface for wear. Carbon sealing surface height shall be 0.040 inch or more as measured at four points 90 degrees apart.

(2) Inspect carbon ring sealing surface for damage.

(a) Visually inspect for nicks and chipping. Nicks or chipping shall not extend, either individually or collectively, across more than ten percent of the radial width of the sealing surfaces, not shall they occupy more than one-eighth of the circumference of either the ID or OD edge of the sealing surface.

(b) Visually inspect for pits. Pits shall not be larger than 0.030 inch across their longest dimension, nor exceed 0.005 inch in depth. Spacing between adjacent edges of pits shall not be less than 0.100 inch.

(c) Visually inspect for scratches. Scratches shall not exceed a depth on 0.001 inch or a width of 0.001 inch, nor a length across more than 30 percent of the radial width of the sealing surface. Spacing between adjacent scratches shall not be less than 0.050 inch.

Spacing between adjacent scratches shall not be less than 0.050 inch.

2. B. (3) Axial response of carbon ring in No. 3 seal. Carbon shall readily return to free height when depressed with light even finger pressure over 360 degrees.

(4) Replace No. 3 seal if inspection requirements of steps (1) through (3) are not met. If No. 3 seal is replaced, it is recommended that mating rotor for seal be replaced.

C. Inspect Rotor (See Figure 202)

(1) Inspect for non-uniform contact pattern, for pitted or deteriorated condition of sealing surface, for metal transfer (pickup) onto sealing surface, and for nicks, gouges, and scratches exceeding 0.0005 inch; any of these conditions is not acceptable. If any crazing can be detected under a strong light by the naked eye, part is not acceptable.

(2) Inspect for burrs in clamping area and rotor bore. Burring preventing correct seating is not acceptable.

(3) If sealing surface is chrome plated, chipping of chrome plating in grooves extending into contact path area is not acceptable.

3. Cleaning/Painting

Table 203. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Scouring pads (red or green Scotch-Brite)	Minnesota Mining and Manufacturing Co, 3M Center, St. Paul, MN 55101
Solvent,Stoddard (Federal Specification P-D-680, Type I)	Commercially available

3. A. Clean Parts

(1) Clean parts as specified in Table 204 in accordance with cleaning methods provided in 72-00-00, GENERAL - CLEANING/PAINTING.

Table 204. Cleaning Methods

Figure No.	Item No.	Nomenclature	Cleaning Methods 1	2	3	5	6	7	8	9
All standard metallic hardware			X	X						
201	20	Nut	X	X						X
	23	Shaft Retainer	X	X						X
	25	Bearing	Refer to Specific Cleaning Procedures.							
202	2	Spacer	X	X						
	3	Spring Washer	X	X						
	4	*Rotor	X	X						X
	5	Shim	X	X						
	8	Retaining Ring	X	X						

*Refer to step 3.A.(2) for alternate cleaning procedure.

(2) Clean rotor (figure 202) using alternate procedure.

CAUTION: WHEN PERFORMING THE FOLLOWING STEP, ENSURE ROTOR IS THOROUGHLY FLUSHED WHILE SCRUBBING TO PREVENT SCORING FACE OF ROTOR WITH CARBON PARTICLES.

Scrub rotor with scouring pad (red or green Scotch-Brite) while flushing with solvent, Stoddard (Federal Specification P-D-680, Type I). Flush rotor continuously while scrubbing to wash away carbon particles which may score face of rotor.

BORESCOPE INSPECTION PLUG AND ENGINE MOUNT BUSHINGS INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

NOTE: Engine mount bushings on engine support housing are not removed unless damage is indicated by inspection. Refer to 2, Inspection/Check.

R

A. Remove Borescope Inspection Plug (See Figure 201)

If applicable, remove bolt and washer. Remove borescope inspection plug, then remove packing from end of plug.

B. Install Borescope Inspection Plug (See Figure 201)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

Install packing on end of plug and install plug. If applicable, secure plug with bolt and washer. Tighten bolt (1) to torque of 50 inch-pounds or tighten plug (5) to torque of 120 inch-pounds.

R

2. Inspection/Check

A. Check Engine Mount Bushings (See Figure 201)

Check for missing or loose bushing at sixteen locations for bolts used to secure forward engine mounts on engine support housing. Replace any loose or missing bushings in accordance with 4, Approved Repairs.

R B. Inspect Borescope Inspection Plug (See Figure 201)

R Inspect borescope inspection plug for cracks, distortion,
R and stripped threads. Replace borescope inspection plug if
R inspection requirements not met.

3. Cleaning/Painting

A. Clean Parts

(1) Clean all standard metallic hardware in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method No. 1 or 2.

(2) Clean borescope inspection plug in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method No. 1, 2, or 9.

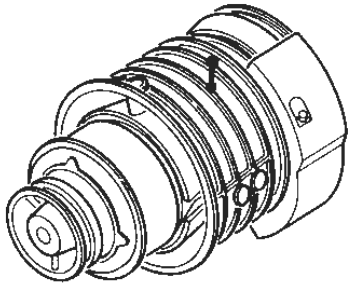
4. Approved Repairs

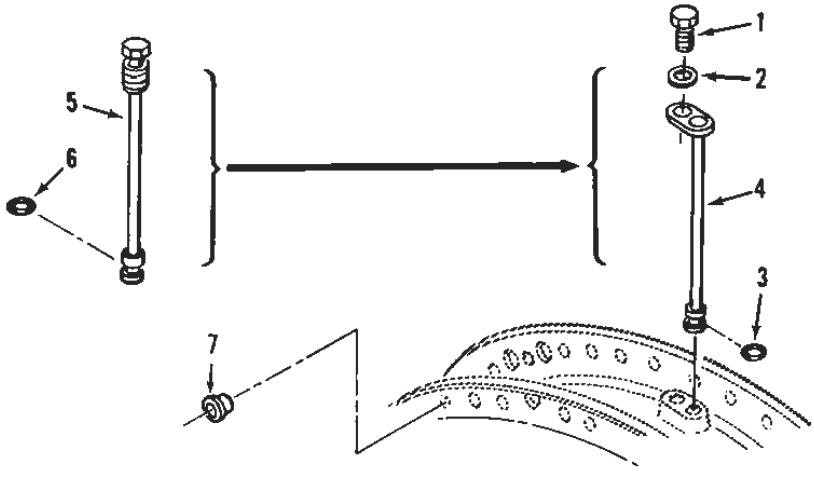
A. Replace Loose or Missing Engine Mount Bushing (See Figure 201)

(1) If required, drive out and discard loose bushing.

(2) Measure diameter of hole for bushing. Select a new bushing which provides a 0.0003 to 0.0016 inch interference fit. If required, use Bushing Part No. 3072738-2 and machine mating diameter for hole to provide required fit.

(3) Press new bushing into place.





1. BOLT (IPC FIG. 115)
2. WASHER
3. PACKING
4. BORESCOPE INSPECTION PLUG
5. BORESCOPE INSPECTION PLUG
6. PACKING
7. ENGINE MOUNT BUSHING

Borescope Inspection Plug and
Engine Mount Bushings Installation
Figure 201

CHAPTER 72 - COMBUSTION SECTION

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COMBUSTION SECTION - DESCRIPTION AND OPERATION

1. General

The combustion section is located in the rear portion of the engine and encompasses the turbine section. It provides an area where fuel and air are mixed and ignited. Principal components of the combustion section are the combustion chamber plenum case, combustion chamber liner and high pressure compressor diffuser. The annular combustion chamber liner mates at one end with a slip joint on the diffuser and the turbine interstage transition liner and forms a combustion chamber. The aft end of the combustion chamber liner is supported by three welded tabs and three special stud bolts in the plenum case. The combustion chamber liner contains ports for twelve fuel nozzles and ports for two igniter plugs. Slots, holes and baffles are appropriately located on the inner and outer walls of the combustion chamber liner to control combustion.

The turbine interstage transition liner forms the inner wall for the combustion section. The combustion chamber plenum case, attached to the compressor housing assembly, encloses the entire combustion area, and provides a plenum for compressed air and a cool skin enclosure. The rear end of the plenum provides a mount for the transition duct.

The plenum drain valves drain raw fuel from the combustion section during false starts and shutdowns. The valves are spring-loaded open and are closed by rising air pressure in the combustion section.

COMBUSTION CHAMBER PLENUM CASE DRAIN VALVE AND HIGH PRESSURE BLEED AIR EXTRACTION PORT COVER AND CAP INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
High temperature compound (Fel-Pro C5-A)	Fel-Pro Inc, Div of Felt Products Mfg Co, 7450 N McCormick Blvd, Skokie, IL 60076

A. Remove Drain Valves and Bleed Air Extraction Port Cover (See Figure 201)

R (1) Remove drain valves and gaskets. Remove gasket from
R drain valve.

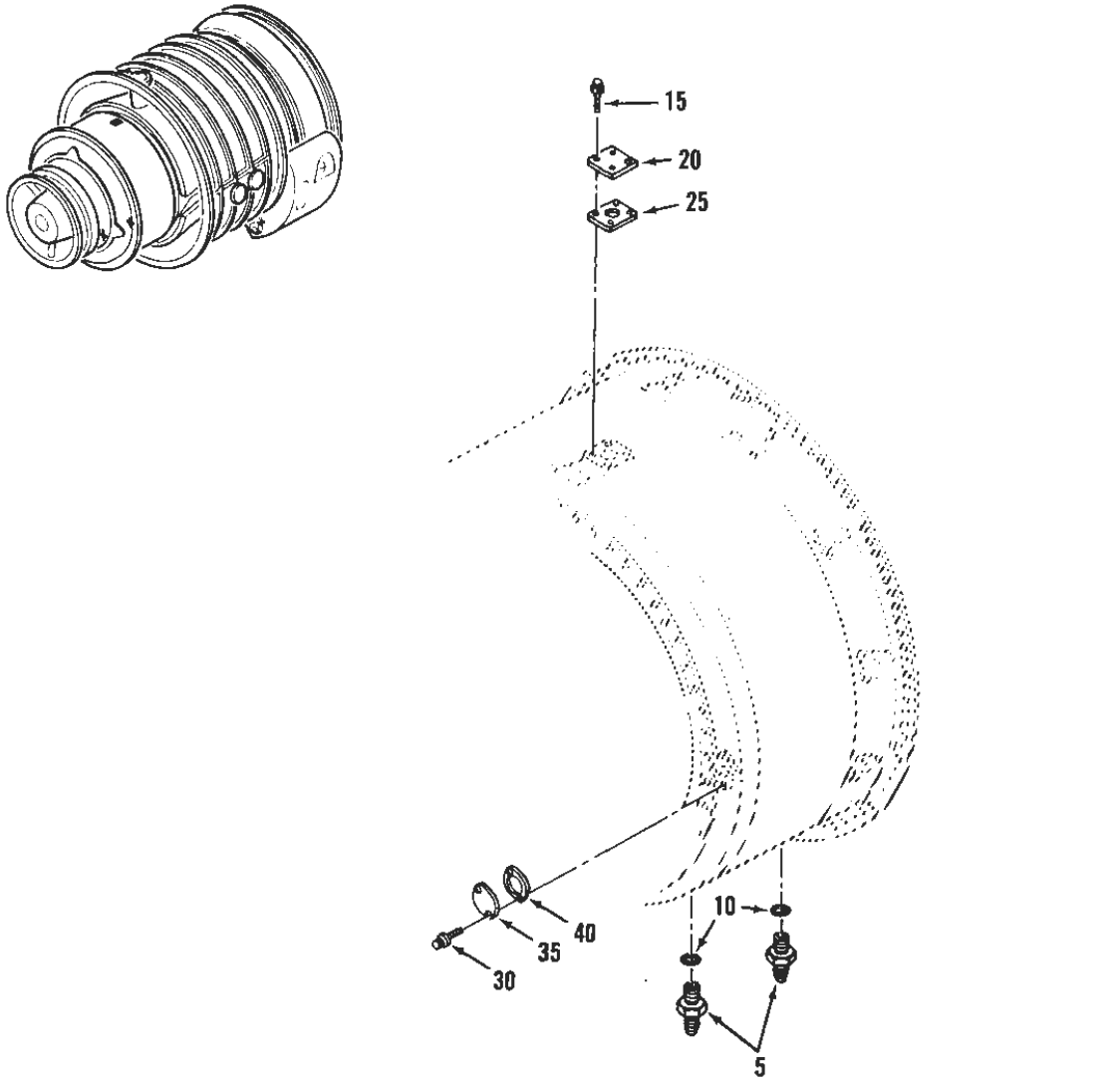
(2) Remove bolts securing bleed air extraction port cover and gasket to plenum. Remove cover and gasket.

R (3) (Codes A, B Post SB72-3085) Remove bolts securing
R bleed air port cap and gasket to plenum. Remove cap
R and gasket.

B. Install Drain Valves and Bleed Air Extraction Port Cover (See Figure 201)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

R (1) (Codes A, B Post SB72-3085) Coat threads of bolts used
R to secure bleed air cap with high temperature compound
R (Fel-Pro C5-A). Install new gasket on plenum, position
R cap over gasket and secure with bolts. Tighten bolts
R (30) to torque of 50 inch-pounds.



R

R 5. DRAIN VALVE (IPC FIG. 133)
R 10. GASKET
R 15. BOLT
R 20. COVER
R 25. GASKET
R

30. BOLT (POST SB72-3085)
35. CAP (POST SB72-3085)
40. GASKET (POST SB72-3085)

Combustion Chamber Plenum Drain Valves and High Pressure Bleed Air Extraction Port Cover and Cap Installation
Figure 201

NOTE: When installing gasket and cover (or gasket and aircraft duct) in the following step, ensure bolt holes in gasket are properly aligned with inserts for bolts in plenum. When shims are installed with aircraft duct, ensure bolt holes in shims and gasket are properly aligned. Misalignment may cause leakage.

1. B. (2) Coat threads of bolts used to secure bleed air extraction port cover with high temperature compound (Fel-Pro C5-A). Install new gasket on plenum, position cover over gasket, and secure with bolts. Tighten bolts (4) to torque of 40 inch-pounds.

R (3) Install new gaskets on drain valves.

R (4) Install drain valves in plenum with arrows on drain
R valves pointing away from plenum. Tighten drain valves
R (5) to torque of 65 inch-pounds.

2. Inspection/Check

A. Inspect Drain Valves

(1) Inspect for foreign material, stripped threads, or distortion of tubing flares.

(2) Clean foreign material from drain valves using acceptable shop practices.

(3) Replace drain valves with stripped threads or distorted tubing flares.

B. Check Drain Valves

(1) Valves shall be capable of being closed by 2.0 to 5.0 psig air pressure.

(2) Replace valves which fail to close properly.

R C. Inspect Bolt Hole Threads in HP Bleed Air Extraction Port

Inspect for damaged threads. Refer to 72-40-04, 4, Approved Repairs if threads are damaged.

3. Cleaning/Painting

A. Clean Parts

(1) Clean all standard metallic hardware in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method No. 1 or 2.

(2) Clean drain valves in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method No. 1 of 2.

COMBUSTION CHAMBER LINER INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Special Tools, Fixtures and Equipment

Item No.	Nomenclature	Use	Source Part No.
NOTE:	Equivalent substitutes may be used for listed items.		
1.	Shaft Support and Alignment Fixture (Codes A, B)	Supports tie rod end.	289783-1
2.	Shaft Support and Alignment Fixture (Code C)	Supports tie rod end.	291926-1
R 3. R	*Low Pressure Shaft Stretching Fixture (with cylinder and pump)	Stretches tie rod.	291960-1 or 291960-2
4.	Combustion Chamber Outer Skirt Pry Bar	Straightens Cooling Skirt	294641-1
5.	Combustion Chamber Inner Skirt Pry Bar	Straightens Cooling Skirt	294612-1
6.	Combustion Chamber Dome Pry Bar	Straightens Cooling Skirt	294564-1

R NOTE: *A fluorescent penetrant inspection in accordance with MIL-I-6866, Type I, on threaded rod and 290489-1 nut of item 3 is required to ensure secviceability at 60 day intervals or after each 100 times fixture is loaded (whichever occurs first). Maintain a permanent record with stretching fixture to record number and dates of fixtures loading and dates of inspections. Life limit of 292374-1 threaded rod and and 290489-1 nut is 6,000 fixture loadings. These components shall be replaced at or before reaching life limit.

Table 202. Materials and Compound

Material or Compound	Manufacturer
CAUTION: ANY SUBSTITUTES USED FOR LISTED INDUSTRIAL MARKING INK OR YELLOW CHINA MARKER SHALL CONTAIN NO CARBON.	
NOTE: Equivalent substitutes may be used for listed items.	
High temperature compound (Fel-Pro C5-A)	Fel-Pro Inc, Div of Felt Products Mfg Co, 7450 N. McCormick Blvd, Skokie, IL 60076
Industrial marking ink (Violet, No. 127-1/2)	Pannier Corp, 206 Sandusky St, Pittsburgh, PA 15212
Lubricating compound (Liqui-Moly, Grade NV, thread compound)	Lockrey Co, Lubricants Div, Cedar Shores, Southampton, NY 11968
Penetrating oil (WD-40)	WD-40 Co, 1061 Cudahy Place, San Diego, CA 92110
Yellow china marker (No. 170T)	Blaisdell Pencil Co, Philmont Rd, Bethagres, PA 19006

1. A. Remove Combustion Chamber Liner (See Figure 201)

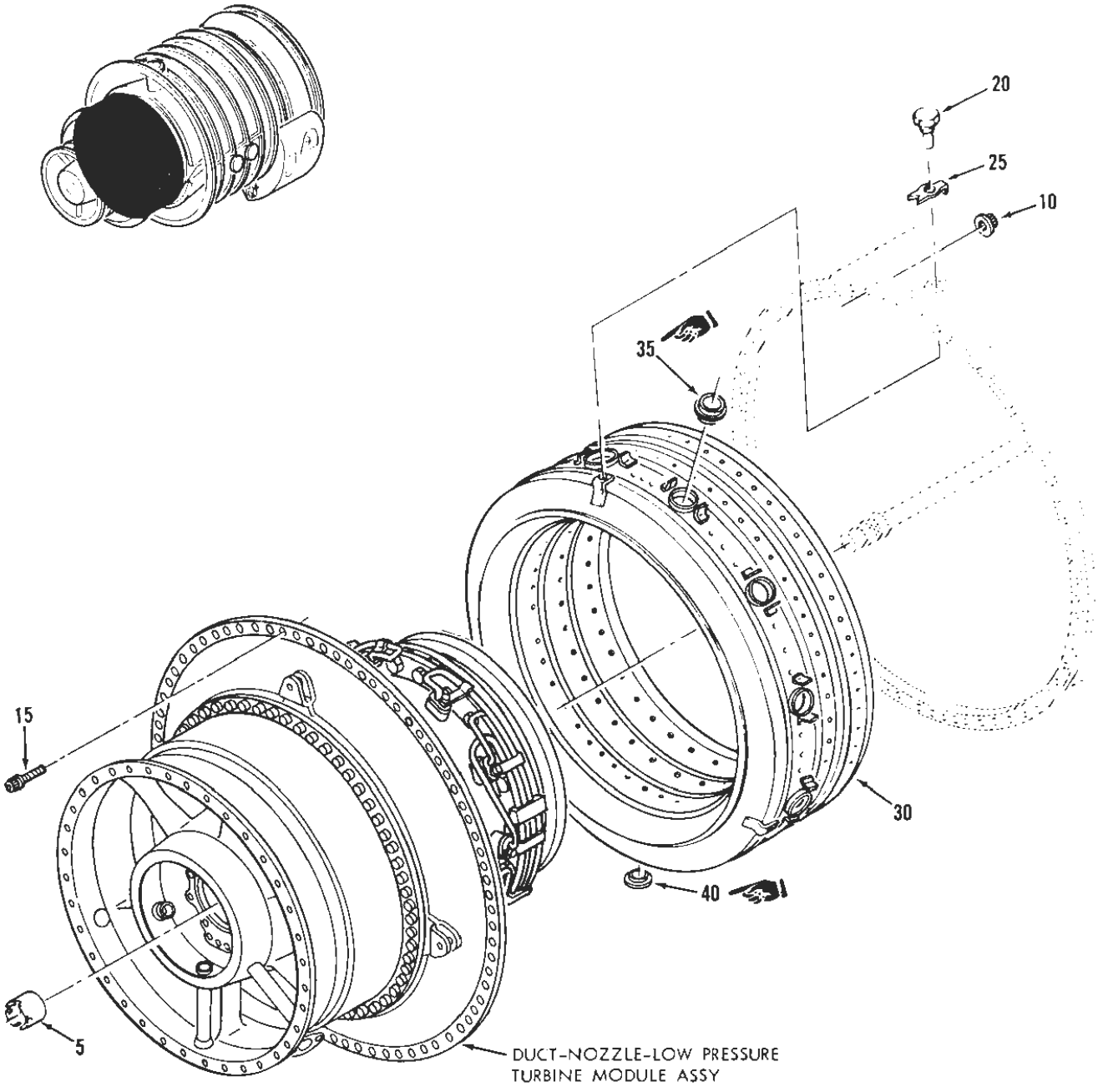
(1) Remove oil tube assemblies connected to bosses on right side and bottom of thrust and exhaust nozzle in accordance with 79-20-04, MAINTENANCE PRACTICES.

(2) Remove N1 transducer access cover plate in accordance with 77-10-03, MAINTENANCE PRACTICES.

(3) Remove rear turbine bearing oil tubes in accordance with 79-20-05, MAINTENANCE PRACTICES.

(4) Remove hardware securing thermocouple harness and N1 transducer leads in accordance with 72-50-03, MAINTENANCE PRACTICES.

(5) Remove N1 transducer installation in accordance with 77-10-03, MAINTENANCE PRACTICES.



5.	TIE ROD NUT (IPC FIG. 99)	25.	LOCKING WASHER
10.	NUT (IPC FIG. 107)	30.	COMBUSTION CHAMBER LINER
R 15.	BOLT	*35.	FUEL GROMMET
R 20.	BOLT (IPC FIG. 108)	*40.	IGNITER GROMMET

R *REMOVE ONLY FOR REPAIR.

Combustion Chamber Liner Installation
Figure 201

1. A. (6) Remove fuel manifold assembly in accordance with 73-10-01, MAINTENANCE PRACTICES.

(7) Remove igniter plugs in accordance with 74-00-01, MAINTENANCE PRACTICES.

NOTE: Removal of the low pressure tie rod nut requires a vibration check after reinstallation. Refer to 72-00-00, GENERAL - ADJUSTMENT/TEST, paragraph 12.

(8) Mark relative positions of turbine module third stage shaft and tie rod with yellow china marker (No. 170T) or industrial marking ink (Violet, No. 127-1/2) to aid at reassembly.

NOTE: Dimensions and respective positions recorded in the following steps are for use at reassembly of the low pressure turbine module to ensure correct tie rod stretch and radial alignment of curvic coupling teeth.

Hand load the turbine module forward (with approximately 15 pounds of force) during all dimensional measurements.

(9) Measure and record Dimension D (on work sheet of Table 203) from Surface A on thrust and exhaust nozzle to Surface B on turbine module third stage shaft. (See figure 202.) Mark points used for measurement using yellow china marker (No. 170T) or industrial marking ink (Violet, No. 127-1/2).

(10) Measure and record Dimension E (on work sheet of Table 203) from Surface A on thrust and exhaust nozzle to Surface C on end of tie rod. (See figure 202.) Mark points used for measurement using yellow china marker (No. 170T) or industrial marking ink (Violet, No. 127-1/2).

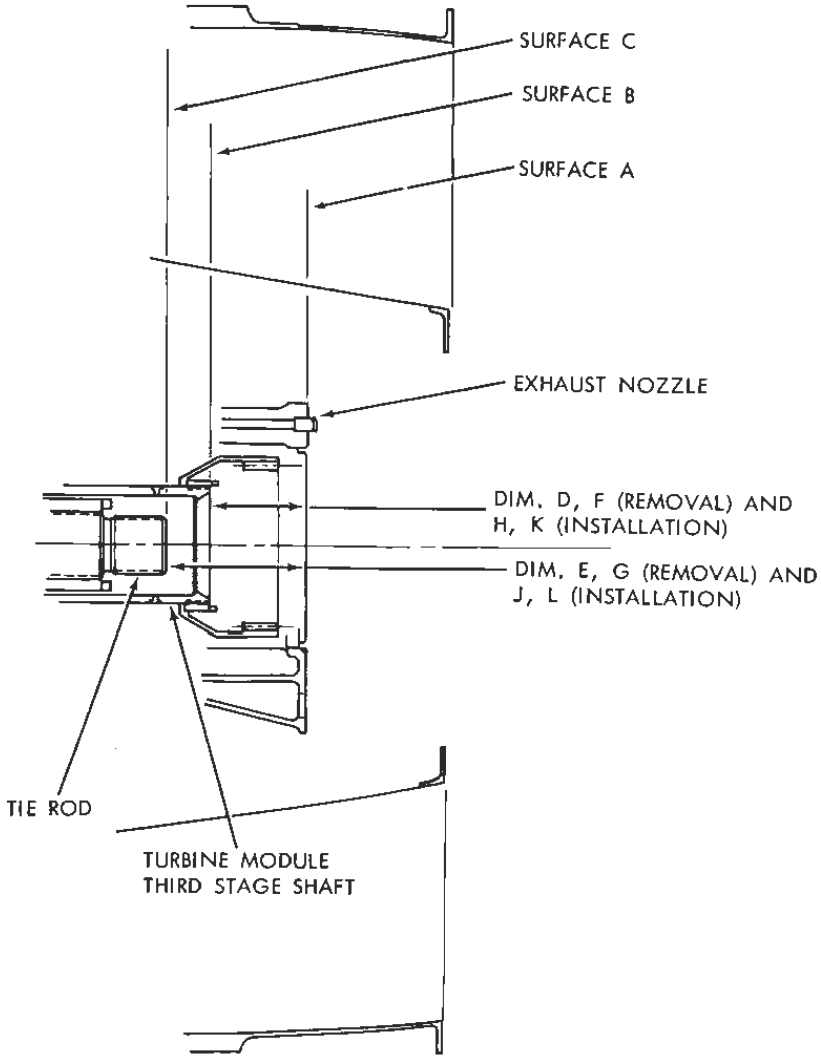
Table 203. Tie Rod Stretch and Curvic Coupling Radial Alignment Worksheet

Date:_____ Engine Serial No.: _____ Technician: _____

	Para. Ref	Dimension to be Recorded (Fig. 202)	Surfaces Measurement (Fig. 202)	Conditions
	LP Turbine Removal			
	1.A.(9)	Dim. D: ____	A to B	Tie rod stretched.
	1.A.(10)	Dim. E: ____	A to C	Tie rod stretched.
	1.A.(12)	Dim. F: ____	A to B	Tie rod unstretched (tie rod nut hand tight).
	1.A.(13)	Dim. G: ____	A to C	Tie rod unstretched (tie rod nut hand tight).
	LP Turbine Installation			
	1.B.(9)	Dim. H: ____	A to B	Tie rod unstretched (tie rod nut hand tight). Dimension H shall equal Dimension F, +0.015/ -0.015* inch.
	1.B.(10)	Dim. J: ____	A to C	Tie rod unstretched (tie rod nut hand tight). Dimension J shall equal Dimension G, +0.015/ -0.015* inch.
R	1.B.(13)	Dim. K: ____	A to B	Tie rod stretched.
R	1.B.(14)	Dim. L: ____	A to C	Tie rod stretched.

NOTE: *If components other than those removed are installed, use tolerance of 0.030 inch instead of 0.015 inch for dimension comparison.

Keep worksheets for each LP turbine removal/ installation performed with permanent engine records.



I-48A-211

Curvic Coupling Teeth Alignment Check
Figure 202

WARNING: DO NOT STAND BEHIND, ABOVE OR BELOW SHAFT STRETCH FIXTURE WHEN PRESSURE IS APPLIED TO FIXTURE IN THE FOLLOWING STEPS. A FAILURE OF FIXTURE OR ENGINE TIE ROD WOULD EXPEL FIXTURE AFT WITH CONSIDERABLE FORCE.

CAUTION: WHEN PERFORMING THE FOLLOWING PROCEDURE, MAKE CERTAIN FORCE SPECIFIED IS NOT EXCEEDED TO ENSURE SHAFT IS NOT OVERSTRETCHED. ENSURE PROPER SPECIAL TOOLING IS USED.

ROD PORTION OF SHAFT STRETCH FIXTURE MUST BE INSTALLED AND POSITIONED AS DESCRIBED IN THE FOLLOWING STEPS PRIOR TO APPLICATION OF PRESSURE TO FIXTURE TO AVOID LOCKING ROD AGAINST NUT.

R 1. A. (11) Loosen tie rod nut as follows when using 291960-1 or
R 291960-2 fixture.

R (a) Disassemble 291960-1 or 291960-2 fixture to
R separate threaded rod and wrench. Clean all fix-
R ture threads and threads on engine. Clean threads
R of fixture components and mating threads for fix-
R ture on engine component. Lubricate threads on
R threaded rod of fixture with a light coat of lu-
R bricating compound (Liqui-Moly, Grade NV, thread
R compound). Install brass nut of fixture onto exposed threads of third stage shaft to protect threads during stretch of tie rod in the following steps. Install brass nut to a depth that positions aft face of nut 0.010 to 0.030 inch forward of end of third stage shaft.

NOTE: Steps (b) through (e) are performed to ensure maximum thread engagement of fixture rod and tie rod before applying hydraulic pressure to fixture.

(b) Apply a small amount of lubricating compound (Liqui-Moly, Grade NV, thread compound) to face of fixture rod which will contact aft face of tie rod nut when rod is bottomed.

(c) Thread fixture rod onto exposed threads of tie rod until rod bottoms against aft face of tie rod nut. Make reference mark on end of fixture rod to aid counting turns, then back fixture rod out, counting turns required to remove rod. Note number of turns required.

1. A. (11) (d) Inspect aft face of tie rod nut to ensure presence of lubricating compound (Liqui-Moly, Grade NV, thread compound). Presence of lubricating compound (Liqui-Moly, Grade NV, thread compound) indicates full engagement of fixture rod with tie rod nut when rod is threaded onto tie rod with number of turns noted in previous step.

CAUTION: A MINIMUM OF NINE AND ONE-FOURTH THREADS SHALL BE ENGAGED WHEN PERFORMING THE FOLLOWING STEP. IF LESS THAN NINE AND ONE-FOURTH TURNS ARE COUNTED WHEN INSTALLING FIXTURE ROD, DO NOT CONTINUE PROCEDURE.

(e) Thread fixture rod onto exposed threads of tie rod to bottoming position, ensuring same number of threads are engaged as noted in step(c).

CAUTION: BACKING FIXTURE ROD OUT FROM BOTTOMING POSITION MORE THAN TWO AND ONE-FOURTH TURNS IN THE FOLLOWING STEP MAY NOT PROVIDE SUFFICIENT THREAD ENGAGEMENT AND CAUSE FAILURE OF TIE ROD OR FIXTURE.

(f) Hold rotating group of engine stationary with hand and back fixture rod out two and one-fourth turns to ensure tie rod nut can be loosened when pressure is applied to fixture.

(g) Slide wrench portion of fixture forward over fixture rod to engage tie rod nut.

(h) Carefully assemble adapter and cylinder assembly of fixture over rod. Secure assembly with fixture bushing and wing nut on end of rod holding fixture forward against third stage shaft of turbine module. Install bushing and wing nut to bottoming position, then back wing nut out one and one-half turns. Ensure rod does not turn with wing nut.

(i) Use hand pressure to align cylinder assembly of fixture concentrically with fixture rod, then apply sufficient pressure with hydraulic pump of fixture to support cylinder in aligned position.

R R R (j) (Post SB72-3119) Slowly continue to apply pressure with hydraulic pump of fixture until fixture pressure gage indicates 4400 psig.

R 1. A. (11) (j1) (Pre SB72-3119) Slowly continue to apply pressure
R with hydraulic pump of fixture until fixture pres-
R sure gage indicates 5550 psig.

CAUTION: WHEN REQUIRED TO INCREASE HYDRAULIC PRESSURE ON FIXTURE AS SPECIFIED IN THE FOLLOWING STEP, DO NOT EXCEED MAXIMUM HYDRAULIC PRESSURE SPECIFIED ON FIXTURE.

1. A. (11) (k) Turn fixture wrench to rotate tie rod nut counterclockwise. If tie rod nut will not loosen, relieve hydraulic pressure on fixture and repeat steps (i) through (k) to loosen tie rod nut. If tie rod nut will not loosen after four repetitions, repeat steps (i) through (k) with hydraulic pressure increased 50 psig over previously used hydraulic pressure. Continue repetitions until tie rod nut is loosened, but do not exceed maximum pressure specified on fixture.

(1) Turn fixture wrench to rotate tie rod nut counterclockwise until tie rod nut bottoms against rod of fixture, then rotate tie rod nut one-half turn clockwise.

(m) Slowly relieve hydraulic pressure. Ensure tie rod nut is loose, then remove fixture. Tighten tie rod nut hand tight.

NOTE: Hand load the turbine module forward (with approximately 15 pounds of force) during all dimensional measurements.

(12) Measure and record Dimension F (on work sheet of Table 203) from Surface A on thrust and exhaust nozzle to Surface B on turbine module third stage shaft. (See figure 202.) Ensure measurement is taken from points marked during initial measurement.

(13) Measure and record Dimension G (on work sheet of Table 203) from Surface A on thrust and exhaust nozzle to Surface C on tie rod. (See figure 202.) Ensure measurement is taken from points marked during initial measurement.

(14) Remove mounting brackets and related hardware from outer bolt circle of transition duct in accordance with 72-50-03, MAINTENANCE PRACTICES.

NOTE: Duct-nozzle-low-pressure turbine module weighs approximately 100 pounds.

(15) Remove tie rod nut. Remove nuts and bolts securing assembled duct-nozzle-low-pressure turbine module assembly to plenum case. Remove assembled duct-nozzle-low-pressure turbine module assembly.

CAUTION: WHEN PERFORMING THE FOLLOWING STEP, BOLTS SHOULD TURN WITHOUT EXCESSIVE FORCE ONCE INITIAL TORQUE IS LOOSENED. WRENCHING BOLTS OUT WHEN THREAD BINDING IS EVIDENT MAY DAMAGE THREADS OF BOSS FOR BOLTS AND NECESSITATE ENGINE REMOVAL.

1. A. (16) Remove bolts and lockwashers securing combustion chamber liner to plenum. If threads of bolt bind after initial torque is loosened, soak bolts with penetrating oil (WD-40) and work loose gradually to avoid damage to threads of bosses for bolts. Remove combustion chamber liner.

(17) (Codes A, B) Install 289783-1 fixture to support aft end of tie rod.

(18) (Code C) Install 291926-1 fixture to support aft end of tie rod.

B. Install Combustion Chamber Liner (See Figure 201)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

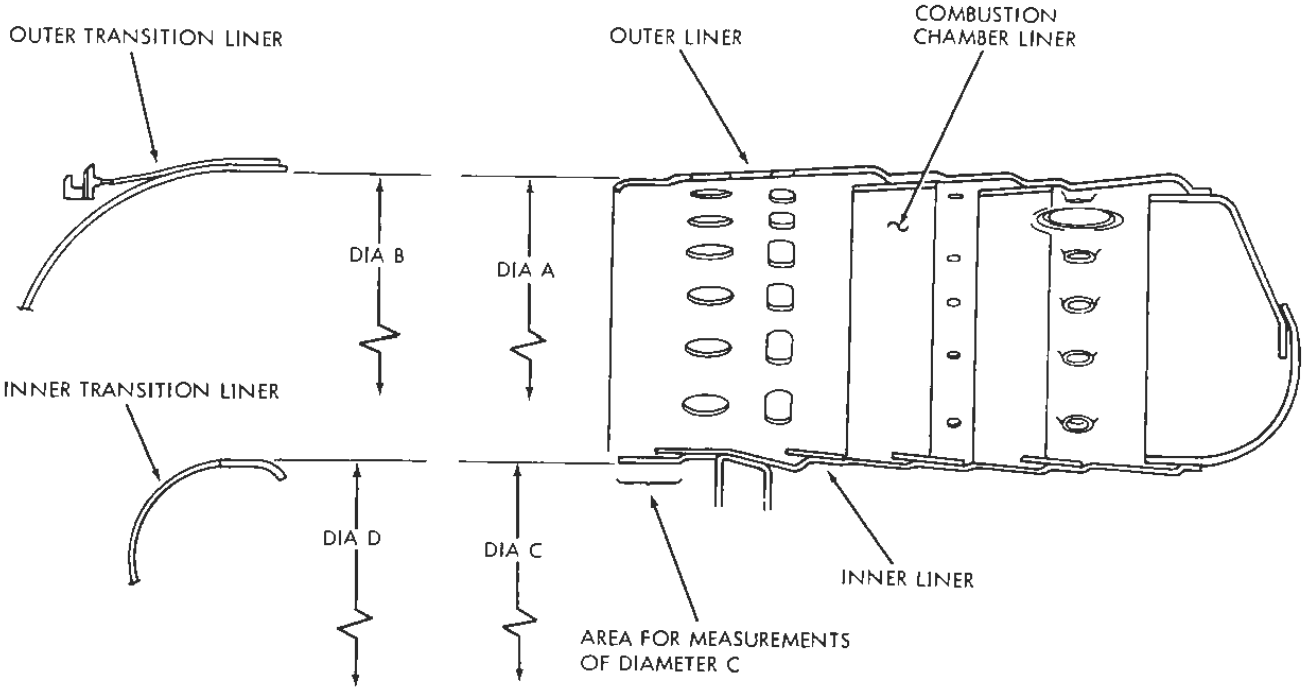
R (1) Check clearance between combustion chamber liner and
R outer transition liner as follows. (See figure 202A.)

R NOTE: An outside diameter pi tape is used in
R the following steps to measure
R diameters. Whenever inside diameter
R measurements are taken, correct the
R dimension by adding twice the pi tape
R thickness to the measured diameter.

R (a) Using pi tape, measure outside diameter of com-
R bustion chamber liner and record as Diameter A.

R (b) Using pi tape, measure inside diameter of outer
R transition liner (figure 201, 72-40-03) and record
R as Diameter B. Diameter A recorded in step (a)
R shall be 0.005 inch larger to 0.015 inch smaller
R than Diameter B. If requirement is not met, refer
R to 4, Approved Repairs to obtain proper dimension.

R



1-48A-584

Combustion Chamber Liner
Clearance Check
Figure 202A

R 1. B. (1a) Check clearance between combustion chamber liner and
R inner transition liner as follows. (See figure 202A.)

R (a) Using pi tape, measure inside diameter of inner
R liner on combustion chamber liner (Diameter C).
R Measure diameter at two places in area indicated
R (figure 202A) and record smallest measurement as
R Diameter C.

R (b) Using pi tape, measure outside diameter of inner
R transition liner (figure 201, 72-50-06) and record
R as Diameter D. Diameter C recorded in step (a)
R shall be 0.015 to 0.025 inch greater than Diameter
R D. If requirement is not met, refer to 4, Ap-
R proved Repairs to obtain proper dimension.

(1b) Remove 289783-1 or 291926-1 fixture supporting tie rod.

(2) Apply high temperature compound (Fel-Pro C5-A) to threads of bolts to secure combustion chamber liner.

(3) Position combustion chamber liner in plenum case and secure with bolts and new lockwashers. Align combustion chamber liner as required to allow bolts to be run in by hand. Tighten bolts (20) to torque of 300 inch-pounds. Bend lock tabs on lockwashers against flats of bolts.

(4) Position duct-nozzle-low-pressure turbine module assembly on plenum case, ensuring indexing marks on turbine module shaft and tie rod are aligned. If turbine module third stage shaft has no indexing marks, install turbine module assembly with high point marks (V or I) on mating curvic couplings 180 degrees apart. Verify engagement by turning turbine module rotating group back and forth and noting that fan rotor assembly rotates. With curvic couplings properly engaged, hand load turbine module forward until tie rod nut is installed.

(5) Apply lubricating compound (Liqui-Moly, Grade NV, thread compound) to threads of tie rod and to threads and face of tie rod nut. Install tie rod nut on tie rod hand tight. Wipe off any access lubricating compound and ensure aft face of tie rod nut is clean.

(6) Apply high temperature compound (Fel-Pro C5-A) to threads of bolts used to secure duct-nozzle-low-pressure turbine module assembly.

(7) Install mounting brackets and related hardware on outer bolt circle of transition duct in accordance with 72-50-03, MAINTENANCE PRACTICES.

1. B. (8) Secure duct-nozzle-low-pressure turbine module assembly with bolts and nuts. Tighten bolts (15) to torque of 80 inch-pounds.

NOTE: Hand load the turbine module forward (with approximately 15 pounds of force) during all dimensional measurements.

(9) Measure and record Dimension H (on work sheet of Table 203) from Surface A on thrust and exhaust nozzle to Surface B on turbine module third stage shaft. (See figure 202.) Ensure measurement is taken from points marked during removal.

(10) Measure and record Dimension J (on work sheet of Table 203) from Surface A on thrust and exhaust nozzle to Surface C on tie rod. (See figure 202.) Ensure measurement is taken from points marked during removal.

NOTE: If components other than those removed are installed, use tolerance of 0.030 inch instead of 0.015 inch when performing the following steps.

R (11) Compare Dimension H (step (9)) with Dimension F (step 1.A.(12)) recorded at removal. Compare Dimension J (step (10)) with Dimension G (step 1.A.(13)) recorded at removal. Compared dimensions shall be same within 0.015 inch. If dimensions are not as specified, curvic coupling teeth are not properly aligned. If required, remove assembled duct-nozzle-low-pressure turbine module assembly and repeat steps (4) through (11) to obtain correct curvic coupling teeth alignment.

WARNING: DO NOT STAND BEHIND, ABOVE OR BELOW SHAFT STRETCHING FIXTURE WHEN PRESSURE IS APPLIED TO FIXTURE IN THE FOLLOWING STEPS. A FAILURE OF FIXTURE OR ENGINE TIE ROD WOULD EXPEL FIXTURE AFT WITH CONSIDERABLE FORCE.

CAUTION: WHEN PERFORMING THE FOLLOWING PROCEDURE, MAKE CERTAIN FORCE SPECIFIED IS NOT EXCEEDED TO ENSURE TIE ROD IS NOT OVERSTRETCHED. ENSURE LOAD REACTS THROUGH ROTATING GROUP AND NOT AGAINST STATIC STRUCTURE. ENSURE PROPER SPECIAL TOOLING IS USED.

R (12) (Post SB72-3119) Stretch tie rod as follows using
R 291960-1 or 291960-2 fixture to obtain dimensional
R stretch of 0.0695 to 0.0715 inch.

R 1. B. (12) (a) Disassemble 291960-1 or 291960-2 fixture to separate threaded rod and wrench. Clean threads of fixture components and mating threads for fixture on engine component. Lubricate threads on threaded rod of fixture with a light coat of lubricating compound (Liqui-Moly, Grade NV, thread compound). Install brass nut of fixture onto exposed threads of turbine module third stage shaft to protect threads during stretch of tie rod in the following steps. Install brass nut to a depth that positions aft face of nut 0.010 to 0.030 inch forward of end of third stage shaft.

NOTE: Steps (b) through (e) are performed to ensure maximum thread engagement of fixture rod and tie rod before applying hydraulic pressure to fixture.

(b) Apply a small amount of lubricating compound (Liqui-Moly, Grade NV, thread compound) to face of fixture rod which will contact aft face of tie rod nut when rod is bottomed.

(c) Thread fixture rod onto exposed threads of tie rod until rod bottoms against aft face of tie rod nut. Make reference mark on end of fixture rod to aid counting turns, then back fixture rod out, counting turns required to remove rod. Note number of turns required.

(d) Inspect aft face of tie rod nut to ensure presence of lubricating compound (Liqui-Moly, Grade NV, thread compound). Presence of lubricating compound (Liqui-Moly, Grade NV, thread compound) indicates full engagement of fixture rod with tie rod nut when rod is threaded onto tie rod with number of turns noted in previous step.

CAUTION: A MINIMUM OF SEVEN THREADS SHALL BE ENGAGED WHEN PERFORMING THE FOLLOWING STEPS. IF LESS THAN SEVEN TURNS ARE COUNTED WHEN INSTALLING FIXTURE ROD, DO NOT CONTINUE PROCEDURE.

(e) Thread fixture rod onto exposed threads of tie rod to bottoming position, ensuring the same number of threads are engaged as noted in step (c). Do not back rod out from this position.

(f) Slide wrench portion of fixture forward over rod to engage tie rod nut.

1. B. (12) (g) Carefully assemble adapter and cylinder assembly of fixture over rod. Secure assembly with fixture bushing and wing nut on end of rod holding fixture forward against third stage shaft of turbine module. Install wing nut to bottoming position then back wing nut out one-fourth turn.

(h) Use hand pressure to align cylinder assembly of fixture aligned concentrically with fixture rod, then apply sufficient pressure with hydraulic pump of fixture to support cylinder in aligned position.

(i) Slowly continue to apply pressure with hydraulic pump of fixture until fixture pressure gage indicates 2700 to 3000 psig. Turn fixture wrench clockwise to seat tie rod nut hand tight. Support cylinder assembly of fixture with hand pressure and slowly relieve pressure on fixture. Thread rod of fixture onto tie rod until rod bottoms on tie rod nut. Engage fixture wrench on tie rod nut. Tighten fixture wing nut on rod of fixture, then back out one-fourth turn.

(j) Align cylinder assembly of fixture concentrically with fixture rod, then apply sufficient pressure with hydraulic pump of fixture to support cylinder in aligned position.

(k) Slowly continue to apply pressure with hydraulic pump of fixture until fixture pressure gage indicates 4400 psig.

(l) Turn fixture wrench clockwise to tighten tie rod nut hand tight.

(m) Slowly relieve hydraulic pressure and remove fixture. Leave brass nut portion of fixture installed on third stage shaft to protect threads.

CAUTION: WHEN REQUIRED TO INCREASE HYDRAULIC PRESSURE ON FIXTURE AS SPECIFIED IN THE FOLLOWING STEP, DO NOT EXCEED MAXIMUM HYDRAULIC PRESSURE SPECIFIED ON FIXTURE.

NOTE: Take measurement at previously made markings.

(n) Measure tie rod stretch to ensure tie rod has been stretched 0.0695 to 0.0715 inch. If stretch is as specified, remove brass nut portion of fixture. If specified stretch is exceeded, apply pressure

with shaft stretch fixture (not to exceed pressure specified for shaft stretch fixture used) sufficient to loosen tie rod nut. Relieve hydraulic pressure on fixture, and repeat steps (12)(a) through (m). If stretch is less than specified, proceed as follows.

1. B. (12) (n) 1) Thread fixture rod onto tie rod to bottoming position.

2) Carefully assemble adapter and cylinder assembly of fixture over tie rod, using care not to damage exposed threads of third stage shaft of turbine module assembly. Secure assembly with wing nut on end of rod, holding fixture forward against third stage shaft of turbine module. Install wing nut to bottoming position, then back wing nut out one-fourth turn.

3) Repeat steps (j) through (m) with hydraulic pressure applied in step (k) increased 50 psig at each repetition of procedure until specified stretch is obtained. Do not exceed maximum hydraulic pressure specified on fixture.

4) Remove brass nut portion of fixture from threads of third stage shaft.

NOTE: Hand load the turbine module forward (with approximately 15 pounds of force) during all dimensional measurements.

(13) Measure and record Dimension K (on work sheet of table 203) from Surface A on thrust and exhaust nozzle to Surface B on turbine module third stage shaft. (See figure 202.) Ensure measurement is taken from points marked during removal.

(14) Measure and record Dimension L (on work sheet of table 203) from Surface A on thrust and exhaust nozzle to Surface C on tie rod. (See figure 202.) Ensure measurement is taken from points marked during removal.

(15) Install igniter plugs in accordance with 74-00-01, MAINTENANCE PRACTICES.

(16) Install fuel manifold assembly in accordance with 73-10-01, MAINTENANCE PRACTICES.

(17) Install N1 transducer installation (except for transducer access cover plate) in accordance with 77-10-03, MAINTENANCE PRACTICES.

1. B. (18) Install hardware securing thermocouple harness and N1 transducer leads in accordance with 72-50-03, MAINTENANCE PRACTICES.

(19) Install rear turbine bearing oil tubes in accordance with 79-20-05, MAINTENANCE PRACTICES.

(20) Install N1 transducer access cover plate in accordance with 77-10-03, MAINTENANCE PRACTICES.

(21) Install oil tube assemblies which connect at bosses on right side and bottom of thrust and exhaust nozzle in accordance with 79-20-04, MAINTENANCE PRACTICES.

(22) Perform vibration check in accordance with 72-00-00, GENERAL - ADJUSTMENT/TEST, paragraph 12 or 13.

2. Inspection/Check

A. Inspect Combustion Chamber Liner (See Figure 203 or 204)

(1) Inspect inner and outer dome panels and dome skirt.

(a) No cracks, burning, or buckling of the inner and outer dome panels or dome skirt are allowed.

R (b) No cracks in support tabs or gussets are allowed.

(c) Inspect dome skirt gaps. Gap shall be 0.095 to
R 0.115 inch. (Refer to table 204.)

(d) Repair items that do not meet inspection requirements of steps (a) through (c) in accordance with 4, Approved Repairs.

(2) Inspect inner liner.

(a) Burned holes not allowed.

(b) No cracks or burning are allowed in cooling skirts No. 1, 2, 3, 4, and 5.

(c) Buckling of cooling skirts No. 1, 2, 3, 4, and 5 or panels (in cooling skirt area) 1, 2, 3, and 4, which closes or opens cooling skirt gap more than allowable dimension is not acceptable. (Refer to
R table 204.)

(d) Buckling of panels 1, 2, 3, and 4, (except in cooling skirt area) up to 0.100 inch is allowable.

R (e) Non-intersecting cracks not exceeding 0.5 inch in
R length are allowable in panels 1, 2, and 3, if no

R local panel buckling or distortion is evident.
R Cooling skirt gaps (table 204) shall be checked
R and maintained especially in areas where cracks
R have occurred. Panel buckling or distortion where
R cracks occur is not allowed.

2. A. (2) (f) Repair items that do not meet inspection requirements of items (a) through (e) in accordance with 4, Approved Repairs.

(3) Inspect outer liner.

(a) Burned holes not allowed.

(b) No cracks or burning are allowed in cooling skirts No. 1, 2, or 3.

(c) Buckling of cooling skirts No. 1, 2, or 3, and panels 1, 2, or 3 (in cooling skirt area) which closes or opens cooling skirt gap more than allowable dimension is not acceptable. Refer to Table
R 204.

(d) Buckling of panels 2 or 3 (except in cooling skirt area) up to 0.150 inch from normal contour over a maximum length of 1.0 inch is allowable.

(e) Buckling of panel 1 shall not exceed limits indicated on Figure 203 or 204, Detail E.

R (f) Non-intersecting cracks not to exceed 0.5 inch in
R length are allowable in panels 1, 2, and 3 if no
R local panel buckling or distortion is evident.
R Cooling skirt gaps (table 204) shall be checked
R and maintained especially in areas where cracks
R have occurred. Panel buckling or distortion where
R cracks occur is not allowed.

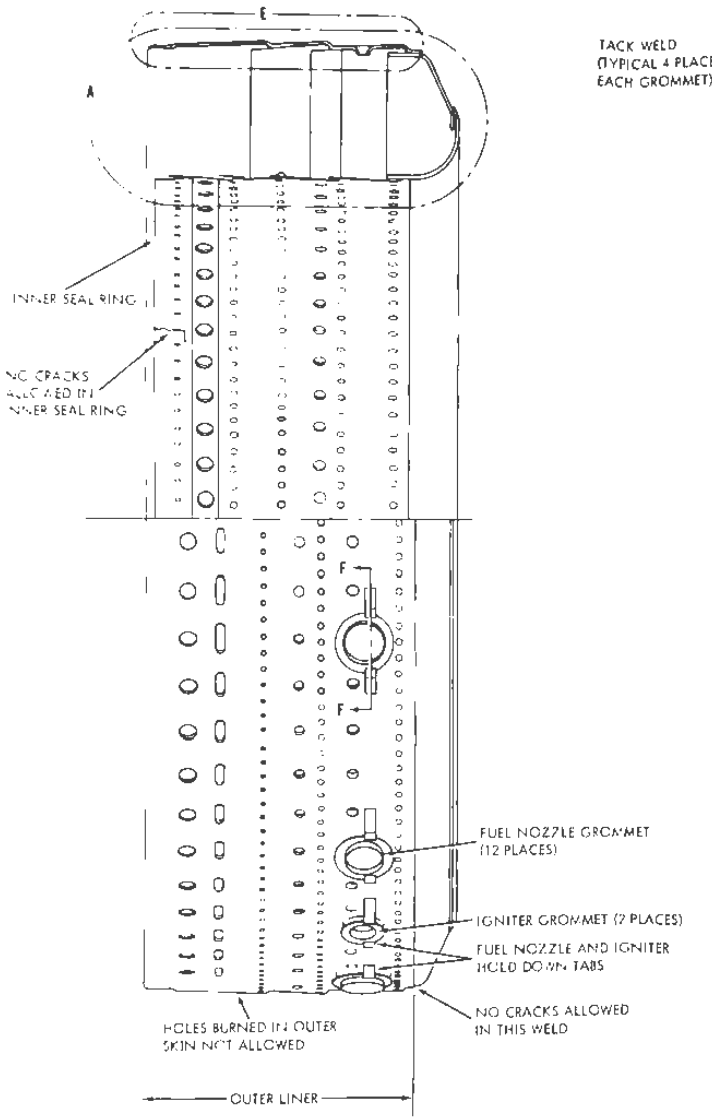
R (g) Fuel nozzle grommets bent or buckled greater than
R 0.010 inch are not acceptable.

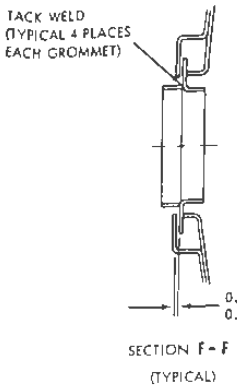
R (h) Cracked tack welds on fuel nozzle grommets are not
R acceptable.

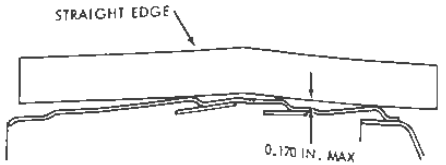
R (i) Igneter grommets bent or buckled greater than
R 0.010 inch are not acceptable.

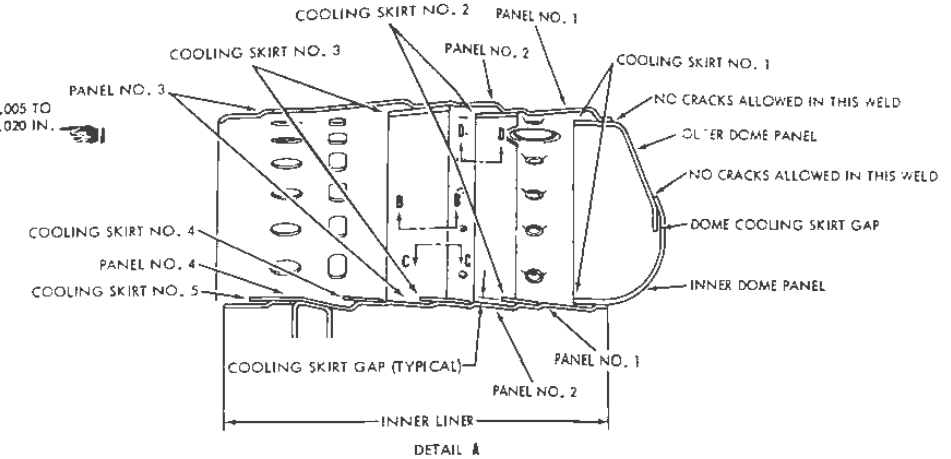
(j) Bent hold down tabs are not acceptable. (See Figure 203 or 204.)

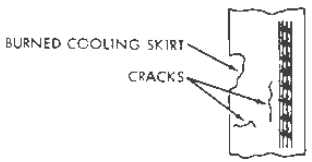
(k) Broken or cracked hold down tabs are not acceptable.



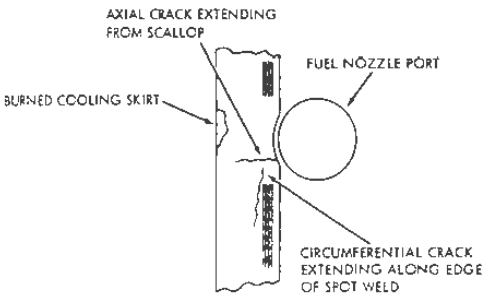








NO. 3 COOLING SKIRT (INNER AND OUTER LINER)
VIEW B-B AND C-C

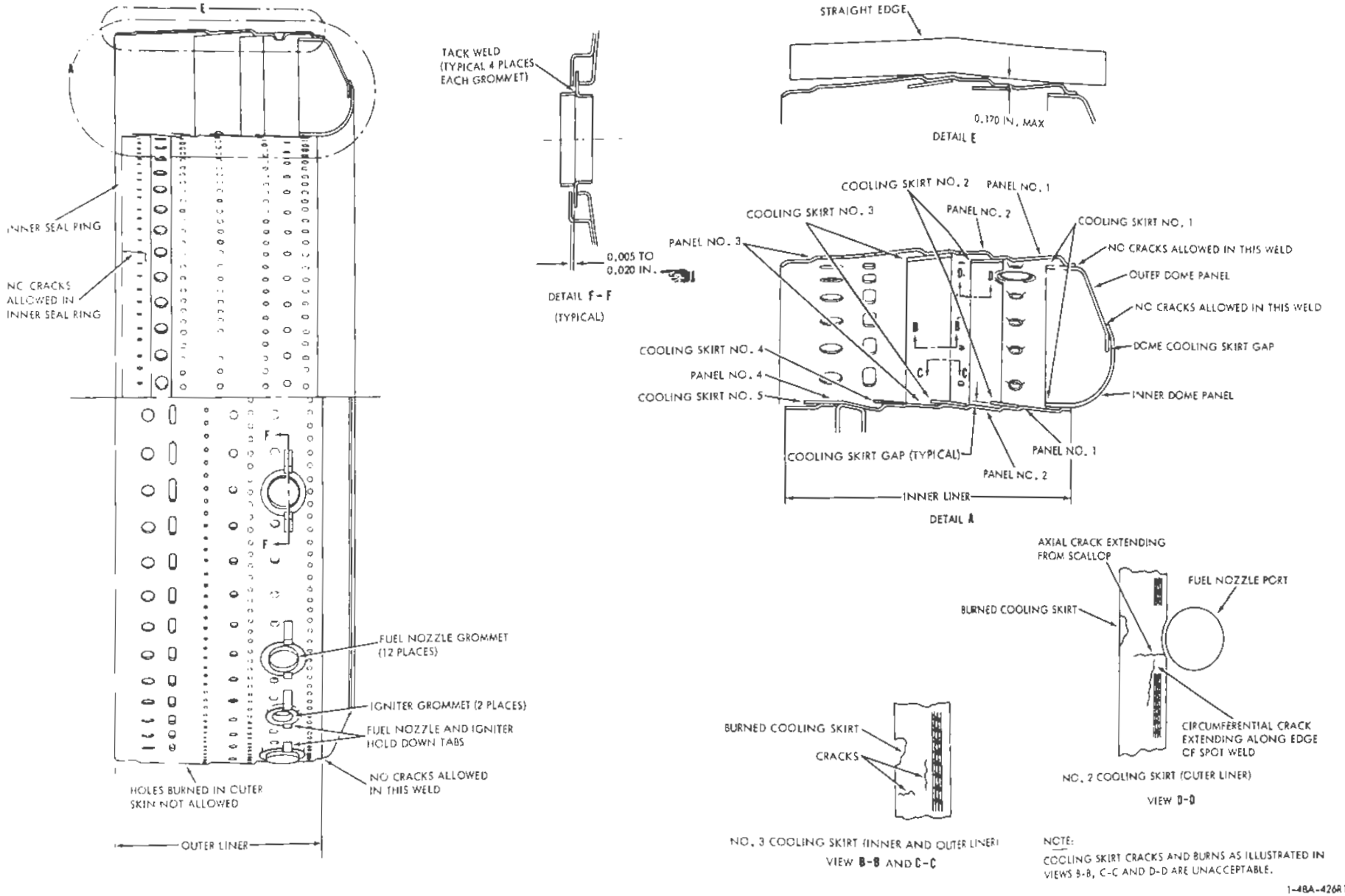

AXIAL CRACK EXTENDING FROM SCALLOP
FUEL NOZZLE PORT
BURNED COOLING SKIRT
CIRCUMFERENTIAL CRACK EXTENDING ALONG EDGE OF SPOT WELD

NO. 2 COOLING SKIRT (OUTER LINER)
VIEW D-D

NOTE:
COOLING SKIRT CRACKS AND BURNS AS ILLUSTRATED IN VIEWS B-B, C-C AND D-D ARE UNACCEPTABLE.

1-48A-424R1

(Pre SB72-3042) Combustion Chamber Liner Inspection
Figure 203



NOTE:
COOLING SKIRT CRACKS AND BURNS AS ILLUSTRATED IN VIEWS B-B, C-C AND D-D ARE UNACCEPTABLE.

1-48A-426R1

(Post SB72-3042) Combustion Chamber Liner Inspection
Figure 204

2. A. (3) (l) Dislodged igniter and fuel nozzle grommets are not acceptable.

(m) Repair items that do not meet inspection requirements of steps (a) through (l) in accordance with 4, Approved Repairs.

R Table 204. Cooling Skirt Gaps

Cooling Skirt	Allowable Gap (inches)
Inner Liner	
R No. 1 and 2	0.045 to 0.065
R No. 3 and 4	0.055 to 0.075
R No. 5	0.035 to 0.055
R Outer Liner	
R No. 1	0.095 to 0.115
R No. 2	0.095 to 0.115
R No. 3	0.075 to 0.095
Dome Skirt	0.095 to 0.115

3. Cleaning/Painting

A. Clean Parts

(1) Clean all standard metallic hardware in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method No. 1 or 2.

(2) Clean combustion chamber liner in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method No. 1, 2, or 9.

4. Approved Repairs

R Table 205. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Filler rod (Haynes 188)	Commercially available

R Table 206. Special Tools, Fixtures and Equipment
R

R Item No.	Nomenclature	Use	Source/ Part No.
R NOTE: Equivalent substitutes may be used for listed item.			
R 1.	Combustion Chamber Liner Expander	Re-size combustion chamber liner.	294918-1

A. Observe General Welding Practices

NOTE: All welding shall be accomplished by qualified personnel certified to Specification MIL-T-5021 and familiar with industry techniques commonly used for welding high temperature alloys.

(1) All repair weldments on the combustion chamber liner shall be by either gas tungston arc welding (GTAW) or plasma arc welding (PAW).

(2) For all weldments, use filler rod (Haynes 188).

(3) When repair by welding a patch or replacement piece is authorized, ensure replacement piece is HS188 material and that thickness of patch is the same as the parent material. Thicknesses are specified in the text where such repair is authorized.

CAUTION: ENSURE THAT FIXTURING USED IN THE FOLLOWING STEP TO OBTAIN A CONTROLLED ATMOSPHERE IS NOT COPPER.

4. A. (4) Completely clean all areas to be welded prior to welding. Perform all welding in a controlled atmosphere, such as obtained using an Argon or vacuum/Argon purge chamber, or suitable fixturing and torch trailer shielding with complete gas backup.

R (5) Do not weld along a brazed seam; however, welding
R across a brazed seam is allowable.

R B. Repair Combustion Chamber Liner (See Figure 205 or 206)

R (1) Straighten panels or skirts (when no cracks or burning
R is evident in buckled area) as shown in Figure 205 or
R 206, View E-E or F-F, as follows.

R (a) When cooling skirt or panel buckling causing cool-
R ing skirt gaps in excess of limits specified in 2,
R Inspection/Check, straighten cooling skirt or
R panel to return gap to within allowable limits.

R (b) Clamp cooling skirt or panel to close gap, or use
R suitable tool to open gap, being careful not to
R damage combustion chamber liner. Suitable tool
R for opening gap is listed in Table 201.

R (2) Weld crack occurring in inner and outer liner panels or
R skirts as shown in Figure 205 or 206 as follows.

R (a) Grind out crack.

R (b) Weld up grind area using filler rod (Haynes 188)
R and procedure in paragraph 4.A.

R (c) Finish grind weld surface smooth.

R (d) Re-drill holes as required where closed by
R welding.

R (e) Straighten buckling of inner and outer liners to
R original contour.

R (3) Repair burned cooling skirts by pathcing as shown in
R Figure 205 or 206, View A-A, B-B, or C-C, as follows:

R (a) Cut out burned cooling skirt section as indicated
R by dashed line.

R 4. B. (3) (b) Fabricate replacement section for removed material. Replacement section shall be HS188 material and of the same thickness as parent skirt material. Use filler rod (Haynes 188) for all weldments. Thickness of cooling skirts is as follows.

Cooling Skirt No. (See figure 203 or 204)	Thickness (in.)
No. 1, outer liner	0.050
No. 2, outer liner	0.063
No. 3, outer liner	0.063
No. 1, inner liner	0.040
No. 2, inner liner	0.032
No. 3, inner liner	0.032
No. 4, inner liner	0.032
No. 5, inner liner	0.032

(c) Weld in replacement piece using filler rod (Haynes 188) and procedure specified in paragraph 4.A.

(d) Finish grind surface smooth after welding.

(e) Re-drill holes as required where closed by welding.

(4) Repair cracked welds securing support tabs and support tab gussets as follows. (See figure 207.)

(a) Grind out crack.

(b) Weld up grind area using filler rod (Haynes 188) and procedures specified in paragraph 4.A.

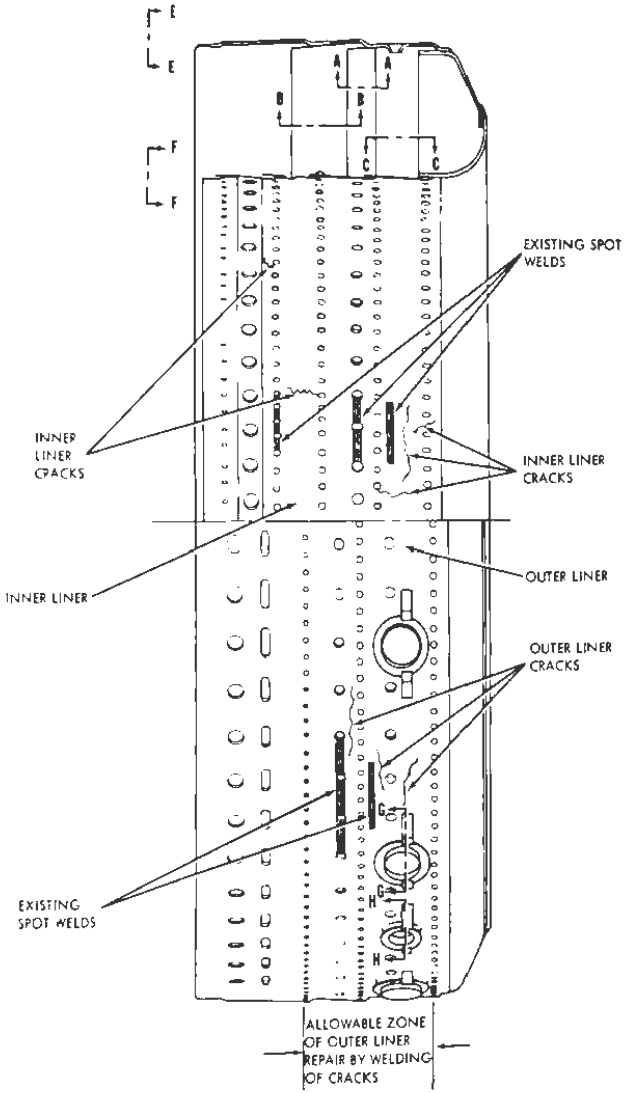
(5) Repair or replace dislodged or bent igniter or fuel nozzle grommets as follows.

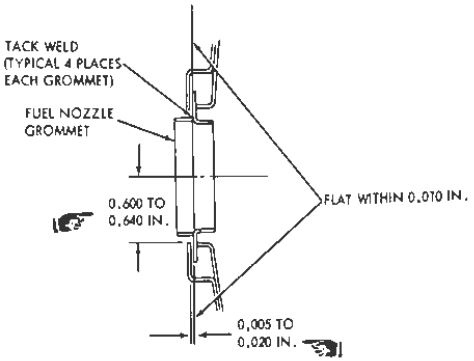
NOTE: When installing grommets, ensure tack welds are facing up.

(a) Straighten bent igniter or fuel nozzle grommets to be flat within 0.010 inch (figure 205 or 206, Section G-G).

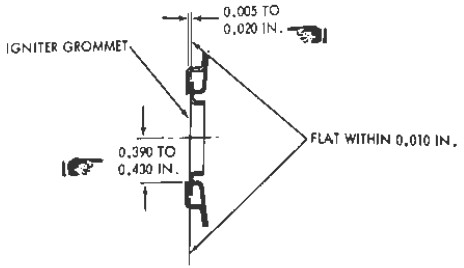
(b) Replace fuel nozzle grommets with cracked tack welds (figure 205 or 206, Section G-G).

(c) Install dislodged, straightened, or replacement igniter or fuel nozzle grommets.

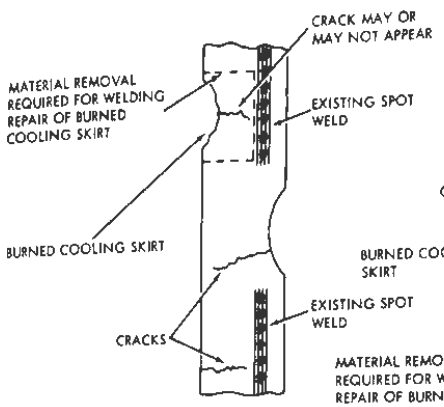




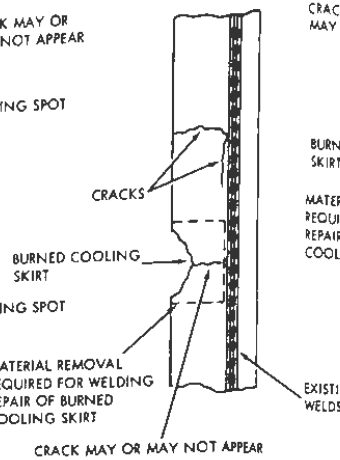
SECTION G-G
(TYPICAL 12 PLACES)



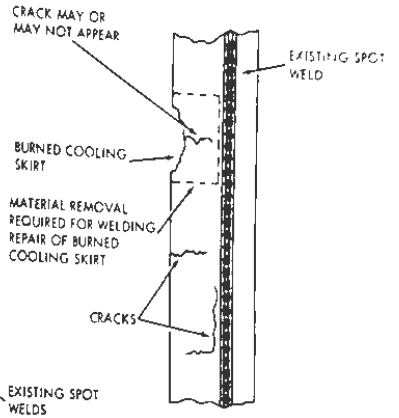
SECTION H-H
(TYPICAL 2 PLACES)


MATERIAL REMOVAL REQUIRED FOR WELDING REPAIR OF BURNED COOLING SKIRT
CRACK MAY OR MAY NOT APPEAR
EXISTING SPOT WELD
BURNED COOLING SKIRT
CRACKS
EXISTING SPOT WELD

VIEW A-A
NO. 2 COOLING SKIRT (OUTER LINER)

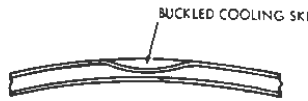

CRACKS
BURNED COOLING SKIRT
MATERIAL REMOVAL REQUIRED FOR WELDING REPAIR OF BURNED COOLING SKIRT
EXISTING SPOT WELDS
CRACK MAY OR MAY NOT APPEAR

VIEW B-B
NO. 3 COOLING SKIRT (OUTER LINER)

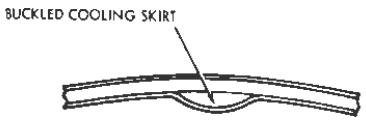

CRACK MAY OR MAY NOT APPEAR
EXISTING SPOT WELD
BURNED COOLING SKIRT
MATERIAL REMOVAL REQUIRED FOR WELDING REPAIR OF BURNED COOLING SKIRT
CRACKS

VIEW C-C
NO. 2, 3, 4, AND 5 COOLING SKIRT (INNER LINER)

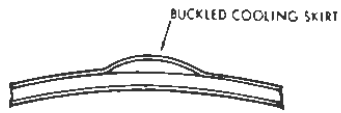
VIEW E-E
OUTER LINER BUCKLED COOLING SKIRT (CLOSING GAP)



VIEW F-F
INNER LINER BUCKLED COOLING SKIRT (CLOSING GAP)



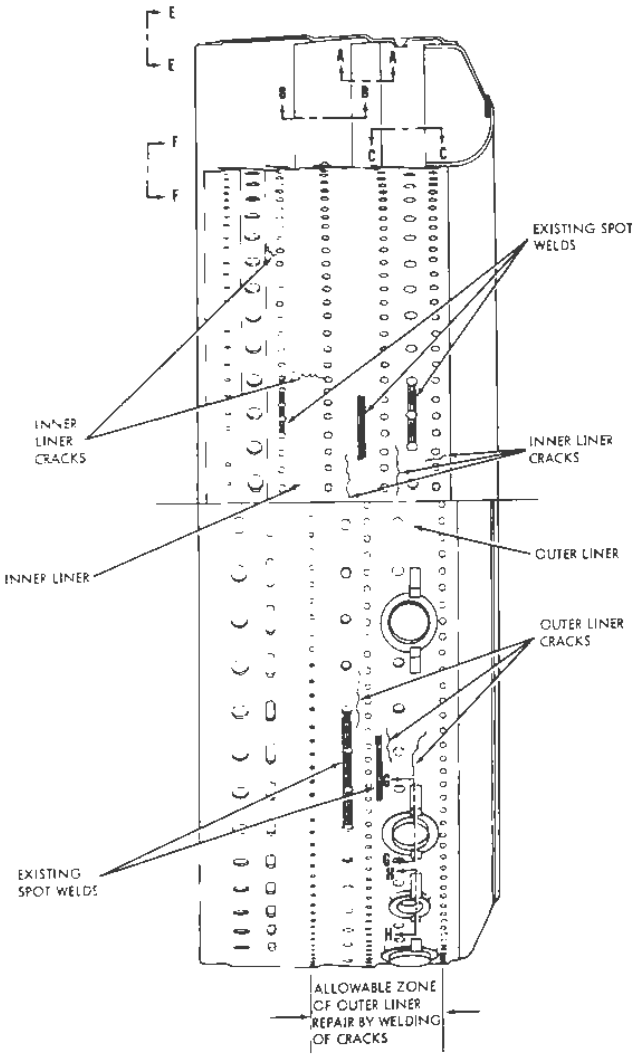
VIEW E-E
OUTER LINER BUCKLED COOLING SKIRT (OPENING GAP)

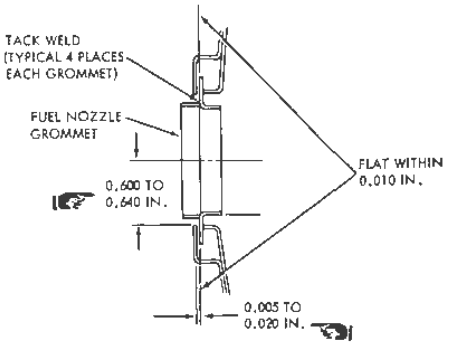


VIEW F-F
INNER LINER BUCKLED COOLING SKIRT (OPENING GAP)

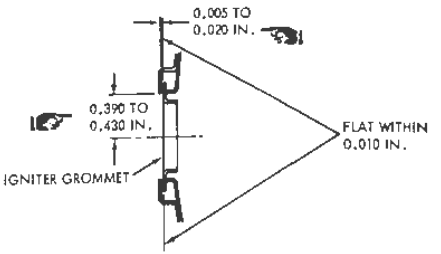
1-48A-425R1

(Pre SB72-3042) Combustion Chamber Liner Repair (Typical)
Figure 205

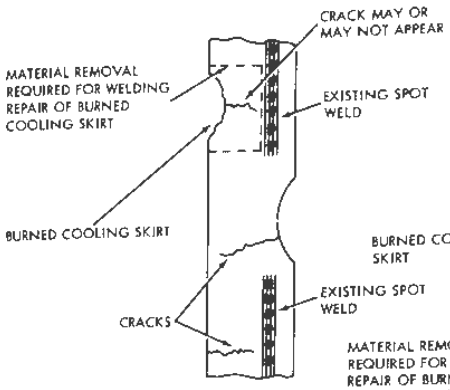




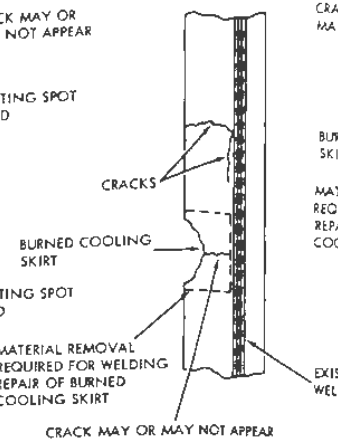
SECTION G - G
(TYPICAL 12 PLACES)



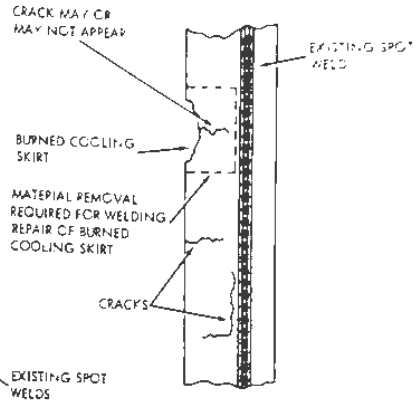
SECTION H-H
(TYPICAL 2 PLACES)


MATERIAL REMOVAL REQUIRED FOR WELDING REPAIR OF BURNED COOLING SKIRT
CRACK MAY OR MAY NOT APPEAR
EXISTING SPOT WELD
BURNED COOLING SKIRT
CRACKS
EXISTING SPOT WELD

VIEW A-A
NO. 2 COOLING SKIRT (OUTER LINER)

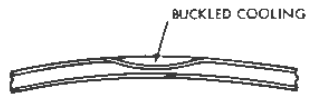

CRACKS
BURNED COOLING SKIRT
MATERIAL REMOVAL REQUIRED FOR WELDING REPAIR OF BURNED COOLING SKIRT
EXISTING SPOT WELDS
CRACK MAY OR MAY NOT APPEAR

VIEW B-B
NO. 3 COOLING SKIRT (OUTER LINER)


CRACK MAY OR MAY NOT APPEAR
EXISTING SPOT WELD
BURNED COOLING SKIRT
MATERIAL REMOVAL REQUIRED FOR WELDING REPAIR OF BURNED COOLING SKIRT
CRACKS

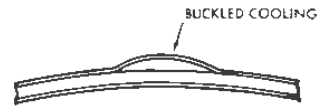
VIEW C-C
NO. 2, 3, 4, AND 5 COOLING SKIRT (INNER LINER)

VIEW E-E
OUTER LINER BUCKLED COOLING SKIRT (CLOSING GAP)



VIEW F-F
INNER LINER BUCKLED COOLING SKIRT (CLOSING GAP)

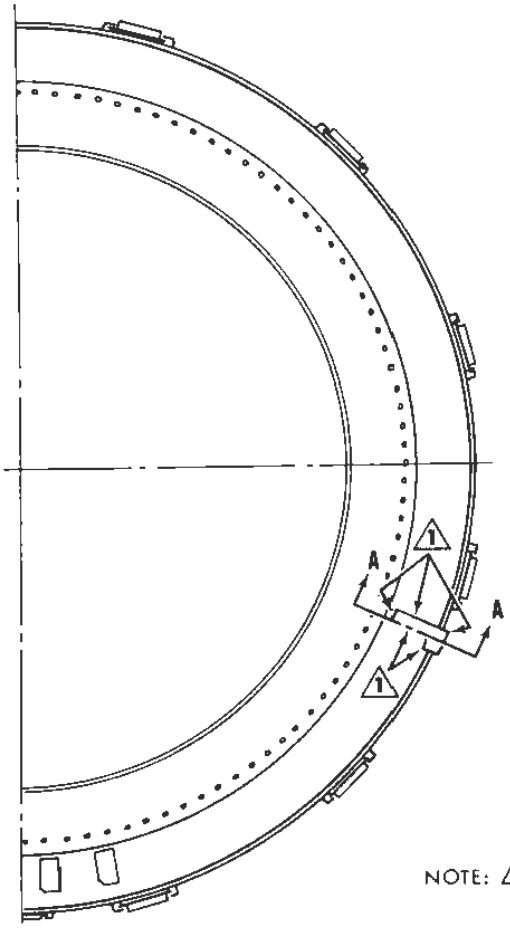
VIEW E-E
OUTER LINER BUCKLED COOLING SKIRT (OPENING GAP)

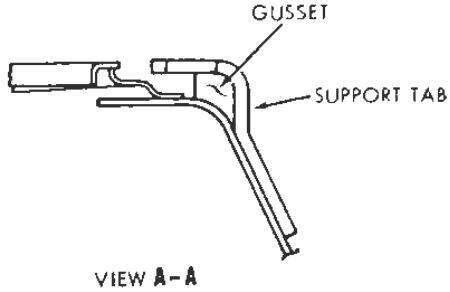


VIEW F-F
INNER LINER BUCKLED COOLING SKIRT (OPENING GAP)

1-48A-427R1

(Post SB72-3042) Combustion Chamber Liner Repair (Typical)
Figure 206





VIEW **A-A**
(TYP 3 PLACES)

NOTE: 1 INDICATES SUPPORT TAB AND GUSSET WELDS

1-48A-208

Repair of Support Tab Welds
Figure 207

4. B. (5) (d) Bend tabs securing igniter and fuel nozzle grommets maintaining tolerance specified in Figure 205 or 206, Section G-G or H-H.

R (6) Re-size outer liner of combustion chamber liner using
R 294918-1 expander as follows to meet clearance requirement of 1, Removal/Installation.

R NOTE: Outer liner may require expanding 0.020
R to 0.030 inch greater than desired diameter when using 294918-1 expander due
R to metal spring-back rate.

R (a) Install liner on expander with outer liner of
R liner between 295646-15 adapter set and 295646-33
R ring component of expander.

R (b) Apply pressure with hydraulic hand pump of expan-
R der to expand outer liner against 295646-33 ring
R to re-establish roundness.

R (c) Relieve pressure and remove 295646-33 ring.

R (d) With liner reinstalled on 295646-15 adapter set,
R apply and relieve pressure with hydraulic hand
R pump as necessary to obtain required outside di-
R ameter of liner.

R (e) Remove liner from expander.

R (7) Re-size inner liner of combustion chamber liner using
R 294918-1 expander as follows to meet clearance requirement of 1, Removal/Installation.

R NOTE: Inner liner may require expanding 0.020
R to 0.030 inch greater than desired diameter when using 294918-1 expander due
R to metal spring-back rate.

R (a) Install 295646-29 spacer ring of expander in for-
R ward cooling skirt gap of liner.

R (b) With liner installed on 295646-15 adapter set, ap-
R ply and relieve pressure with hydraulic hand pump
R as necessary to obtain required inside diameter.

R (c) Remove liner from expander and remove spacer ring
R from liner.

4. C. Perform Inspection Following Repair (Including Straightening)

(1) Perform fluorescent penetrant inspection in accordance with Specification MIL-I-6866, Type I, Method A.

(2) Inspect combustion chamber liner in accordance with 2, Inspection/Check.

OUTER TRANSITION LINER - MAINTENANCE PRACTICES

1. Removal/Installation

NOTE: Liner cannot be removed at maintenance level.

A. Removal of Components for Inspection of Outer Transition Liner

(1) Remove oil tube assemblies connected to bosses on right side and bottom of thrust and exhaust nozzle in accordance with 79-20-04, MAINTENANCE PRACTICES.

(2) Remove N1 transducer access cover plate in accordance with 77-10-03, MAINTENANCE PRACTICES.

(3) Remove rear turbine bearing oil tubes in accordance with 79-20-05, MAINTENANCE PRACTICES.

(4) Remove hardware securing thermocouple harness and N1 transducer leads in accordance with 72-50-03, MAINTENANCE PRACTICES.

(5) Remove N1 transducer installation in accordance with 77-10-03, MAINTENANCE PRACTICES.

(6) Remove fuel manifold assembly in accordance with 73-10-01, MAINTENANCE PRACTICES.

(7) Remove igniter plugs in accordance with 74-00-01, MAINTENANCE PRACTICES.

(8) Remove mounting brackets and related hardware from outer bolt circle of transition duct in accordance with 72-50-03, MAINTENANCE PRACTICES.

(9) Remove assembled duct-nozzle-low-pressure turbine module and combustion chamber liner in accordance with 72-40-02, MAINTENANCE PRACTICES.

(10) Remove high pressure turbine rotor and nozzle assemblies in accordance with 72-50-06, MAINTENANCE PRACTICES.

B. Installation of Components after Inspection of Outer Transition Liner

(1) Install high pressure turbine rotor and nozzle assemblies in accordance with 72-50-06, MAINTENANCE PRACTICES.

1. B. (2) Install combustion chamber liner and assembled duct-nozzle-low-pressure turbine module in accordance with 72-40-02, MAINTENANCE PRACTICES.

(3) Install mounting brackets and related hardware on outer bolt circle of transition duct in accordance with 72-50-03, MAINTENANCE PRACTICES.

(4) Install igniter plugs in accordance with 74-00-01, MAINTENANCE PRACTICES.

(5) Install fuel manifold assembly in accordance with 73-10-01, MAINTENANCE PRACTICES.

(6) Install N1 transducer installation (except for transducer access cover plate) in accordance with 77-10-03, MAINTENANCE PRACTICES.

(7) Install hardware securing thermocouple harness and N1 transducer leads in accordance with 72-50-03, MAINTENANCE PRACTICES.

(8) Install rear turbine bearing oil lines in accordance with 79-20-05, MAINTENANCE PRACTICES.

(9) Install N1 transducer access cover plate in accordance with 77-10-03, MAINTENANCE PRACTICES.

(10) Install oil tube assemblies which connect at bosses on right side and bottom of thrust and exhaust nozzle in accordance with 79-20-04, MAINTENANCE PRACTICES.

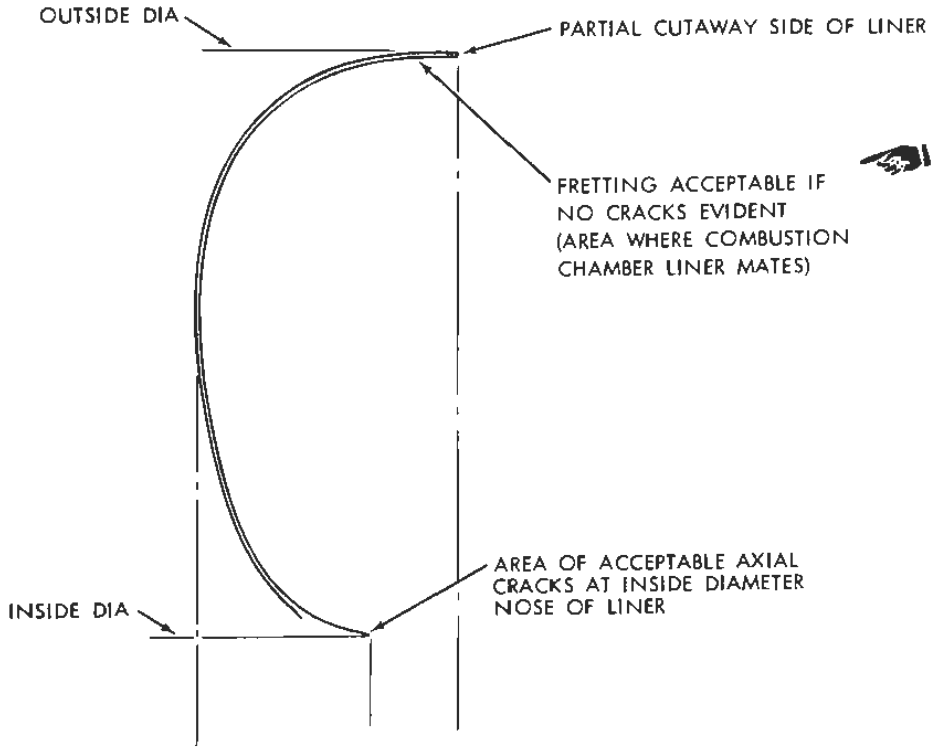
2. Inspection/Check

A. Inspect Outer Transition Liner

(1) Inspect liner for cracks. Axial cracks at the inside diameter nose of liner (figure 201) are acceptable if crack length does not exceed 0.250 inch and no more than 20 cracks are present. Maximum gap for crack at inside diameter nose of liner is 0.005 inch. Circumferential cracks at inside or outside diameter of liner are not allowed.

R

(2) Inspect liner both visually, using a mirror as required, and by feel, for distortion. Inspect entire surface for buckling or warpage. Buckling up to 0.250 inch is acceptable.


OUTSIDE DIA
PARTIAL CUTAWAY SIDE OF LINER
FRETTING ACCEPTABLE IF NO CRACKS EVIDENT (AREA WHERE COMBUSTION CHAMBER LINER MATES)
AREA OF ACCEPTABLE AXIAL CRACKS AT INSIDE DIAMETER NOSE OF LINER
INSIDE DIA

1-48A-303R1

R

Inspection of Outer Transition Liner
Figure 201

COMBUSTION CHAMBER PLENUM CASE - MAINTENANCE PRACTICES

1. Inspection/Check

A. Inspect Combustion Chamber Plenum Case

R (1) Visually inspect for nicks or scratches in areas at R least one-half inch away from any boss weld, flange, or R axial weld.

R (a) Nicks and scratches are acceptable provided they R are no deeper than 0.008 inch and that they have a R minimum concave radius of 0.004 inch at the maxi- R mum depth.

R (b) Nicks and scratches that are deeper than 0.008 R inch or do not have a minimum concave radius of R 0.004 inch at the maximum depth must be blend R repaired.

R (c) Repair of nick or scratch shall not reduce wall R thickness to less than 0.039 inch.

R (d) Maximum allowable distortion across a two inch R square encompassing the nick is 0.020 inch.

R (e) Nicks which meet requirements may be repaired in R accordance with Approved Repairs, paragraph 2.A.

R (2) Visually inspect for nicks that are within one-half R inch of any boss weld, flange, or axial weld.

R (a) Nicks and scratches are acceptable provided they R are no deeper than 0.008 inch and that they have a R minimum concave radius of 0.004 inch at the maxi- R mum depth. Also, the sheetmetal thickness below R the nick must not be less than 0.042 inch.

R (b) Nicks and scratches within one-half inch of any R axial or flange weld that are deeper than 0.008 R inch or do not have a minimum concave radius of R 0.004 inch at the maximum depth must be blend R repaired provided the repair does not reduce the R wall thickness to less than 0.042 inch.

R (c) Nicks or scratches within one-half inch of any R boss weld may be inspected using digital thickness R gage per paragraph 2.A.(3). Nicks and scratches R that can be repaired by blending and not reducing R wall thickness more than 0.008 inch during blend- R ing operation shall be repaired in accordance with R Approved Repairs, paragraph 2.B.

R 1. A. (3) Visually inspect bolt hole threads in high pressure
R bleed air ports.

R Inspect for damaged threads. Damaged threads may be
R repaired in accordance with Approved Repairs, Paragraph
R 2.C.

2. Approved Repairs

Table 201. Materials, Compounds, and Equipment

Materials, Compound, or Equipment	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Calibration block(s) (Specify type of material and thickness desired)	Automation Industries, Inc, Sperry Division, 9822 Everest St, Downey, CA 90242 (May be locally fabricated, if desired.)
Case (Leather) (Specify for Model G2-B) (Optional)	Automation Industries, Inc, Sperry Division, 9822 Everest St, Downey, CA 90242
Concentrated hydrochloric acid (HCl)	Commercially available
Cupric chloride (Cu Cl2)	Commercially available
Digital thickness gage (Model G2-B)	Automation Industries, Inc, Sperry Division, 9822 Everest St, Downey, CA 90242
Grinding wheels (Norton B82 (preferred) or B84, Grit 38A120, Grade TVM)	Available from Garrett Industrial Supply Co, 6015 Randolph St, Los Angeles, CA 90022
HI Transducer (Specify for Model G2-B)	Automation Industries, Inc, Sperry Division, 9822 Everest St, Downey, CA 90242
LO Transducer (Specify for Model G2-B)	Automation Industries, Inc, Sperry Division, 9822 Everest St, Downey, CA 90242

Table 201. Materials, Compounds, and Equipment (Cont)

Materials, Compound, or Equipment	Manufacturer
Methanol (methyl alcohol) (Federal Specification O-M-232)	Commercially available
Portable fluorescent penetrant kit (ZA-43)	Magnaflux Corp, 7300 W Lawrence Ave, Chicago, IL 60656
Rubberized abrasives (Cratex 8-C and 80-C)	Available from Garrett Industrial Supply Co, 6015 Randolph St, Los Angeles, CA 90022
Sodium carbonate	Commercially available
Solvent, Stoddard (Federal Specification P-D-680, Type I)	Commercially available
Sonic couplant (glycerine)	Commercially available
Tape (Electro Platers No. 484)	3M Company Adhesives, Coatings and Sealers Div, 3M Center, St. Paul, MN 55101

Table 202. Special Tools, Fixtures and Equipment

Item No.	Nomenclature	Use	Part No.
NOTE: Equivalent substitutes may be used for listed item.			
1.	Plenum Wall Thickness Gage	Measure plenum case wall thickness to ensure serviceability after repair.	294299-1

NOTE: Weld repairs are not allowed on combustion chamber plenum case.

R 2. A. Repair Nicks or Scraches In Plenum Case

R (1) Repair nicks or scratches in areas one-half inch away
R from any boss weld, flange, or axial weld.

R Blend and polish to remove nick using 0.10 inch di-
R ameter minimum grinding wheel. Minimum diameter of blend area is 0.75 inch. Final surface finish shall be AA32 or better with no scratches or flaws. Wall thickness of repaired area shall be no less than 0.039 inch after repair.

R 2. A. (2) Repair nicks or scratches in areas with-in one-half
R inch of any flange or axial weld.

R Blend and polish to remove nick using a 0.10 inch di-
R ameter minimum grinding wheel. Minimum diameter of
R blend area is 0.75 inch. Final surface finish shall be
R AA32 or better with no scratches or flaws. Wall thick-
R ness of repaired area shall be no less than 0.042 inch
R after repair.

(3) Verify wall thickness after repair using digital thickness gage (Model G2-B).

NOTE: Material specification of plenum case wall areas is Inconel 718, per AMS5596.

Use a calibration block of known thickness and material similar to thickness and material being checked for calibration.

Refer to instructions supplied with digital thickness gage for identification and function of components.

(a) Place sonic couplant (glycerine) on calibration block (an amount necessary to give transducer (pickup) a complete contact with mating surface).

(b) Connect LO transducer to digital thickness gage. Set three toggle switches to LO, AUTO, and ON.

(c) Calibrate digital thickness gage to calibration block by placing transducer (pickup) on calibration block where sonic couplant (glycerine) has been placed, then adjust dials as necessary to obtain a digital readout equivalent to thickness of calibration block. Break contact and reset transducer (pickup) on calibration block several times to verify reading. Readjust if necessary.

(d) Place sonic couplant (glycerine) on surface to be checked (repair area) (an amount necessary to give transducer (pickup) a complete contact with mating surface).

(e) Place transducer (pickup) on surface to be checked where couplant (glycerine) had been placed, and note digital readout. Break contact and reset transducer (pickup) on surface to be checked several times to verify reading.

2. A. (3) (f) Reverify thickness of calibration block and surface to be checked several times to ensure that readings obtained are accurate.

(g) Turn toggle switch of OFF. Remove ID transducer. Wipe surfaces clean.

NOTE: Weld repairs are not allowed on combustion chamber plenum case.

R B. Blend Repair Nicks, Scraches, Linear Indications in Weld, or Cracks at Weld-to-Sheet Metal Interface of Fuel Nozzle Bosses, Igniter Plug Bosses, Aft Plenum Drain Valve Boss, or Bosses for Bolts Used to Secure Combustion Chamber Liner.

NOTE: 294299-1 plenum wall thickness gage is designed for measuring small thickness variations from a calibrated thickness. Accuracy of readout declines as thickness of material measured increases or decreases from calibration point. This is due to angular motion of calipers, which rotate about a pivot point. For example, when properly calibrated for thickness of 0.050 inch, gage will not read exactly zero when ends of calipers are touching.

Proper use of 294299-1 plenum wall thick-ness gage requires calipers to be aligned perpendicular to material being measured. When not perpendicular, a higher erroneous reading will be ohtained. When using gage, always position calipers to obtain smallest reading possible at point being measured.

(1) Calibrate 294299-1 plenum wall thickness gage with a 0.050 inch precision gage block. Measure and record sheet metal thickness adjacent to nick, linear indication or crack on weld. Subsequent grinding operations shall not reduce sheet metal thickness more than 0.008 inch, and shall not reduce sheet metal thickness to less than 0.042 inch. (See table 203.)

Table 203. Materials Removal Limits

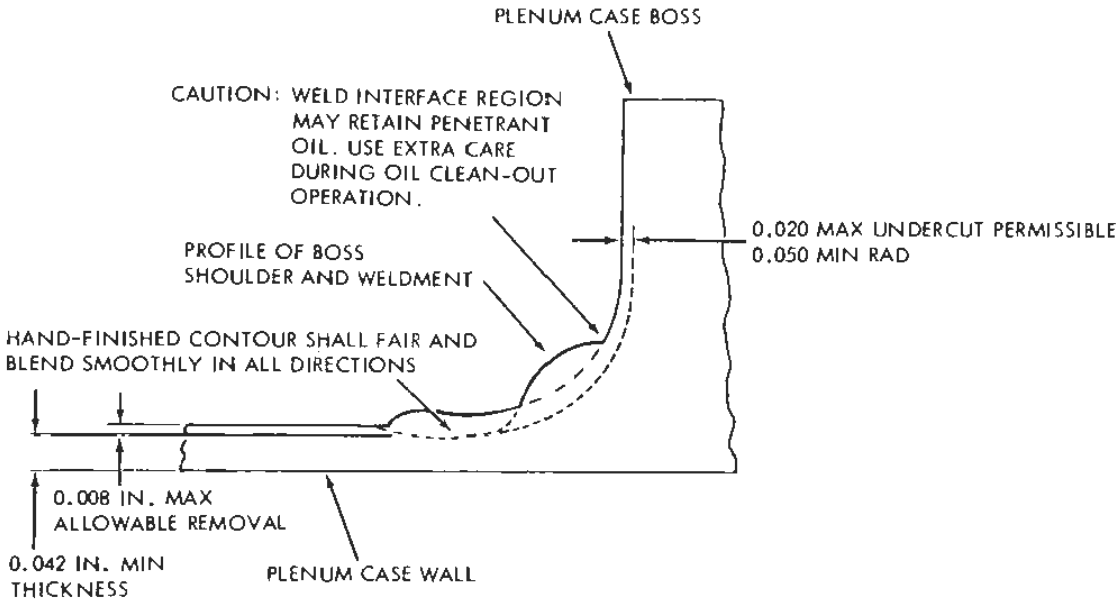
Recorded Sheet Metal Thickness	Maximum Blend Limit
0.050 inch or greater	Material removal to depth of 0.008 inch allowed
Less than 0.050 inch	Material removal to reduce wall thickness to 0.042 inch minimum allowed

CAUTION: IF LIMITS OF MATERIAL REMOVAL SPECIFIED IN THE FOLLOWING STEP ARE EXCEEDED, ENGINE MUST BE RETURNED TO A GARRETT APPROVED REPAIR CENTER.

R 2. B. (2) Blend to completely remove nicks, scratches, linear in-
R dications in weld, or cracks determined at inspection (72-00-00, General-Inspection/ Check, paragraph 18). See Figure 201 and Table 203 for material removal limits. Grinding shall be performed with rotary power driven grinding wheels (Norton B82 or B84, Grit 38A120, Grade TVM) using variable speed (0 to 15,000 rpm) drive motor. Blend all repaired areas smoothly. Verify
R removal of nick, scratch, linear indication or crack by reinspection. Remove minimum amount of material required to meet inspection requirements. Grinding operation shall not reduce wall thickness of plenum case to less than 0.042 inch, and shall remove no more than 0.008 inch material. Measure wall thickness with 294299-1 plenum wall thickness gage after calibrating dial indicator of gage with a 0.050 inch precision gage block. (Nominal wall thickness of plenum case is 0.050 inch.) If repair cannot be accomplished without exceeding applicable specified limit, return engine to a Garrett approved repair center.

WARNING: CHEMICALS USED IN THE FOLLOWING PROCEDURE ARE HARMFUL TO PERSONNEL. WEAR PROTECTIVE COVERINGS TO PREVENT CONTACT WITH SKIN. PREPARE AND USE CHEMICALS IN A WELL-VENTILATED AREA AND AVOID BREATHING FUMES.

(3) Prepare Kallings Modified Etchant for treatment of hand-finished areas as follows: mix one gram of cupric chloride (Cu Cl2), four milliliters of concentrated hydrochloric acid (HCl), and four milliliters of methanol (methyl alcohol) (Federal Specification O-M-232).


PLENUM CASE BOSS
CAUTION: WELD INTERFACE REGION MAY RETAIN PENETRANT OIL. USE EXTRA CARE DURING OIL CLEAN-OUT OPERATION.
0.020 MAX UNDERCUT PERMISSIBLE
0.050 MIN RAD
PROFILE OF BOSS SHOULDER AND WELDMENT
HAND-FINISHED CONTOUR SHALL FAIR AND BLEND SMOOTHLY IN ALL DIRECTIONS
0.008 IN. MAX ALLOWABLE REMOVAL
0.042 IN. MIN THICKNESS
PLENUM CASE WALL

NOTE:
DO NOT REMOVE MORE MATERIAL THAN REQUIRED TO REMOVE LINEAR INDICATIONS OR CRACKS DETERMINED AT INSPECTIONS.

1-48A-383R1

R R R Maximum Material Removal for Repair of Nicks, Scratches, Linear Indications or Cracks in Plenum Case Boss Welds (Typical)
Figure 201

WARNING: WHEN PERFORMING THE FOLLOWING STEP, USE ACETONE IN A WELL-VENTILATED AREA. AVOID INHALATION OF FUMES AS VAPOR IS TOXIC. WEAR SOLVENT-RESISTANT GLOVES TO AVOID ABSORPTION OF SOLVENT THROUGH THE SKIN.

2. B. (4) Thoroughly clean areas hand-finished in accordance with step (1) using magnaflux cleaner (ZC-7) (part of fluorescent penetrant inspection kit (ZA-43)) or equivalent.

(5) Mask off areas around hand-finished areas and over open boss ports using tape (Electro Platers No. 484) to prevent etchant from running or dripping to other areas of the plenum or other engine components when performing the following steps.

(6) Using cotton swab, apply previously prepared etchant for three to four minutes to repaired areas on boss welds. Keep cotton swab continuously moving on repaired areas throughout etchant application period.

CAUTION: USE EXTREME CARE TO PREVENT ANY DILUTED ETCHANT FROM RUNNING INTO AREAS OF ENTRAPMENT WHEN PERFORMING THE FOLLOWING STEP.

(7) Carefully wash hand-finished areas with water to remove etchant, then wipe and blot hand-finished areas dry.

R R (8) Thoroughly wash hand-finished areas with 10 percent (by weight) solution of sodium carbonate.

(9) Rinse hand-finished areas with water, then wipe hand-finished areas dry.

(10) Remove tape (Electro Platers No. 484) used for masking on part.

(11) Repeat inspection (72-00-00, GENERAL - INSPECTION/CHECK, paragraph 18). If required, repeat steps (1) through (11) Continue repeating blending, etching, and inspection operations (steps (1) through R (10)) until all linear indications are removed, or limits of Figure 201 and Table 203 are exceeded.

(12) Polish repaired areas with power-driven rubberized abrasive (8-C and 80-C). Surface funish of repaired areas shall be AA32 or better.

2. C. Repair Damaged Bolt Hole Threads in HP Bleed Air Extraction Port and Fuel Nozzle Body Mount Bosses

(1) Ensure that minimum edge distance exists from centerline of existing hole with damaged threads to edge of boss. Minimum edge distance of 0.22 inch is required to perform the following procedure.

CAUTION: THREADED HOLES IN HP BLEED AIR EXTRACTION PORT COVER BOSS ARE BLIND HOLES. EXISTING HOLES SHALL NOT BE DEEPENED WHEN PERFORMING THE FOLLOWING PROCEDURE. DRILLING THROUGH BLIND HOLE TO INTERIOR OF PLENUM WILL REQUIRE REPLACEMENT OF COMBUSTION CHAMBER PLENUM CASE.

(2) Fabricate a drill stop to prevent drilling operation of subsequent step from deepening existing holes.

(3) Drill out damaged threads using 0.196 to 0.202 inch drill, using drill stop to ensure hole is not deepened.

(4) Tap drilled hole for Heli-Coil 1191-3CN-01900 insert (Mite Corp, Heli-Coil Products Div, Shelter Rock Lane, Danbury CT 06810) as specified by insert manufacturer.

(5) Clean hole using solvent, Stoddard (Federal Specification P-D-680, Type I).

(6) Install insert in accordance with insert manufacturer instructions.

R

CHAPTER 72 - TURBINE SECTION

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TURBINE SECTION - DESCRIPTION AND OPERATION

1. General

The turbine section of the engine consists essentially of those components located in the rear portion of the engine and enclosed by the combustion section. The principal components of the turbine section are a first stage turbine, which is a single-stage axial flow high pressure type, and a second stage turbine, which is a three-stage axial flow low pressure type. The turbines are mounted on separate concentric shafts with the low pressure shaft passing through the interior of the high pressure shaft.

The low pressure turbine module is connected to the low pressure compressor assembly through curvic teeth. The turbine interstage transition liner separates the turbine section from the combustion section.

The forward end of the shaft is supported by a thrust absorbing ball bearing. The rear portion of the low pressure turbine is supported by a single roller bearing mounted in the turbine exhaust nozzle. An air-oil carbon seal is mounted forward of the roller bearing in the turbine exhaust nozzle to prevent oil from entering the low pressure turbine cavity.

LOW PRESSURE TURBINE ROLLER BEARING INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Special Tools, Fixtures and Equipment

Item No.	Nomenclature	Use	Source/ Part No.
NOTE:	Equivalent substitutes may be used for listed items.		
1.	Bearing Installing Mechanical Puller	Installs bearing.	289752-1
2.	Bearing Removal Mechanical Puller	Removes bearing.	291262-1 or 293711-1
3.	Spring Compressor	Compresses spring washer.	293077-1
NOTE:	*291262-1 puller is used to remove 358750-1 bearing. 293711-1 puller is used to remove either 358750-1 or 358750-2 bearing by interchanging ring component of puller.		

A. Remove Roller Bearing (See Figure 201)

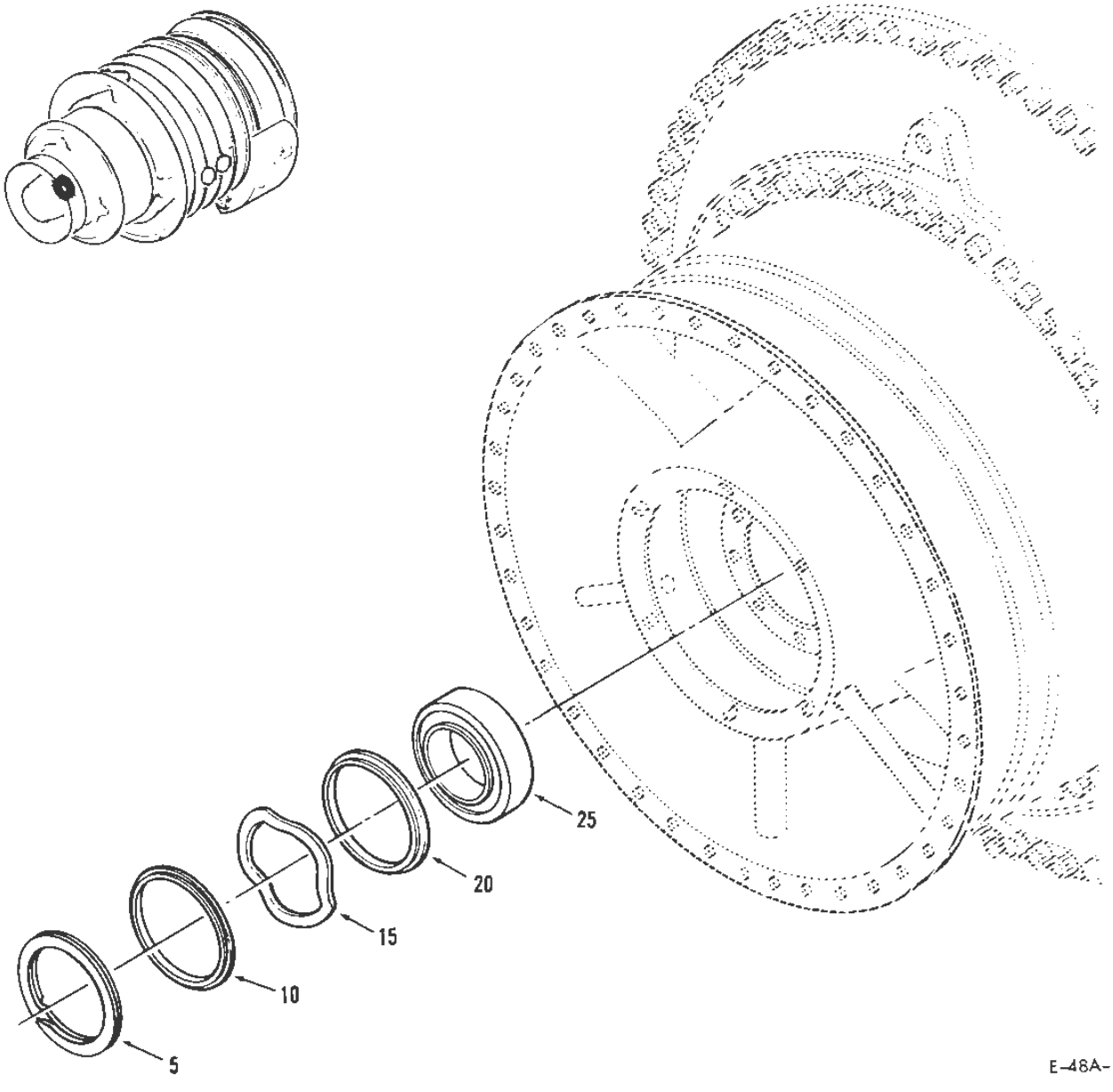
(1) Remove oil tube assemblies connected to bosses on right side and bottom of thrust and exhaust nozzle in accordance with 79-20-04, MAINTENANCE PRACTICES.

(2) Remove N1 transducer access cover plate in accordance with 77-10-03, MAINTENANCE PRACTICES.

(3) Remove rear turbine bearing oil tubes in accordance with 79-20-05, MAINTENANCE PRACTICES.

(4) Remove hardware securing N1 transducer lead in accordance with 72-50-03, MAINTENANCE PRACTICES.

(5) Remove N1 transducer installation in accordance with 77-10-03, MAINTENANCE PRACTICES.



R 5. SPIRAL RETAINING RING
R (IPC FIG. 96)
R 10. RETAINING RING
15. SPRING WASHER
20. THRUST PLATE
25. ROLLER BEARING

Low Pressure Turbine Roller Bearing Installation
Figure 201

1. A. (6) Compress spring washer using 293077-1 spring compressor. Tilt outer diameter of spiral retaining ring out so end of retaining ring may be pulled out, then remove spiral retaining ring. Remove 293077-1 spring compressor.

(7) Remove retaining ring, spring washer, and thrust plate.

(8) Determine part number of bearing installed. Part number of bearing appears on aft side of both inner and outer races of bearing.

NOTE: (Post SB72-3033) Use 293771-1 puller to remove Bearing Part No. 358750-1 or 358750-2.

(Pre SB72-3033) Use 291262-1 puller to remove Bearing, Part No. 358750-1.

(9) Remove inner race of bearing using 291262-1 or 293711-1 puller, as applicable, as follows. (When using 293711-1 puller, ensure proper ring component of puller is installed. 293711-21 ring is installed on puller to remove Bearing, Part No. 358750-1. 293711-2 ring is installed on puller to remove Bearing, Part No. 358750-2.)

(a) Slide puller ring fully to rear.

(b) Unscrew puller jackscrew to expand puller fingers enough to clear aft shoulder of bearing inner race.

(c) Seat pilot of puller on end of low pressure tie rod, with puller fingers aligned with puller groove of bearing inner race. Screw jackscrew on puller forward to close puller fingers in bearing groove.

(d) Slide puller ring fully forward to lock puller fingers in puller groove of bearing inner race.

(e) Screw jackscrew of puller forward to pull bearing inner race off turbine module third stage shaft.

(10) Remove outer race of bearing by hand.

B. Install Roller Bearing (See Figure 201)

CAUTION: WHEN INSTALLING BEARING OUTER RACE, ENSURE THAT OUTER RACE DOES NOT HANG UP ON BEARING ROLLERS.

(1) Install bearing inner race (puller groove to rear) on shaft with 289752-1 puller until inner race bottoms. Ensure cooling holes on bearing inner race are not lined up with holes on turbine module third stage shaft.

(2) Install bearing outer race so that bevel, faces forward.

(3) Install thrust plate, spring washer and retaining ring. Forward retaining ring has an interference fit. Compress spring washer using 293077-1 spring compressor. Install spiral retaining ring. Verify that spiral retaining ring is in groove.

(4) Install N1 transducer installation (except for transducer access cover plate) in accordance with 77-10-03, MAINTENANCE PRACTICES.

(5) Install hardware securing N1 transducer lead in accordance with 72-50-03, MAINTENANCE PRACTICES.

(6) Install rear turbine bearing oil tubes in accordance with 79-20-05, MAINTENANCE PRACTICES.

(7) Install N1 transducer access cover plate in accordance with 77-10-03, MAINTENANCE PRACTICES.

(8) Install oil tube assemblies which connect at bosses on right side and bottom of thrust and exhaust nozzle in accordance with 79-20-04, MAINTENANCE PRACTICES.

2. Inspection/Check

A. Inspect Bearing

(1) Inspect roller bearing in accordance with 70-00-00, 7. Bearing Handling and Inspection.

3. Cleaning/Painting

A. Clean Parts

(1) Clean spiral retaining ring, retaining ring, spring washer, and thrust plate in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method No. 1, 2, or 9.

(2) Clean roller bearing in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Specific Cleaning Instructions.

THRUST AND EXHAUST NOZZLE INSTALLATION -MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Special Tools, Fixtures and Equipment

Item No.	Nomenclature	Use	Source/ Part No.
NOTE:	Equivalent substitutes may be used for listed items.		
1.	Seal Rotor Mechanical Puller	Removed seal rotor.	289751-1
2.	Installation and Removal Seal Driver	Removes and installs No. 6, Air-oil seal.	289753-1
3.	Mechanical Puller Set	Removes air rotating seal.	289767-1
4.	Pilot (Part of Puller Set 289767-1)	Removes air rotating seal.	289767-13
5.	Turbine Bearing Support Mechanical Puller (Codes A, B)	Removes thrust and exhaust nozzle.	289793-1
6.	Turbine Bearing Support Mechanical Puller (Code C)	Removes thrust and exhaust nozzle.	291928-1
R 7. R R R	Seal Installing Support	Supports thrust and exhaust nozzle when installing No. 6 air-oil seal.	294920-1

Table 202. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
High temperature compound (Fel-Pro C5-A)	Fel-Pro Inc, Div of Felt Products Mfg Co, 7450 N. McCormick Blvd, Skokie, IL 60076
Silver goop (anti-seize)	Crawford Fitting Co, 29500 Solon Rd, Solon, OH 44139
Solvent, Stoddard (Federal Specification P-D-680, Type I)	Commercially available

1. A. Remove Thrust and Exhaust Nozzle (See Figure 201)

(1) Remove N1 transducer access cover plate in accordance with 77-10-03, MAINTENANCE PRACTICES.

(2) Remove oil tube assemblies connected to bosses on right side and bottom of thrust and exhaust nozzle in accordance with 79-20-04, MAINTENANCE PRACTICES.

(3) Remove rear turbine bearing oil tubes in accordance with 79-20-05, MAINTENANCE PRACTICES.

(4) Remove hardware securing thermocouple harness and N1 transducer leads in accordance with 72-50-03, MAINTENANCE PRACTICES.

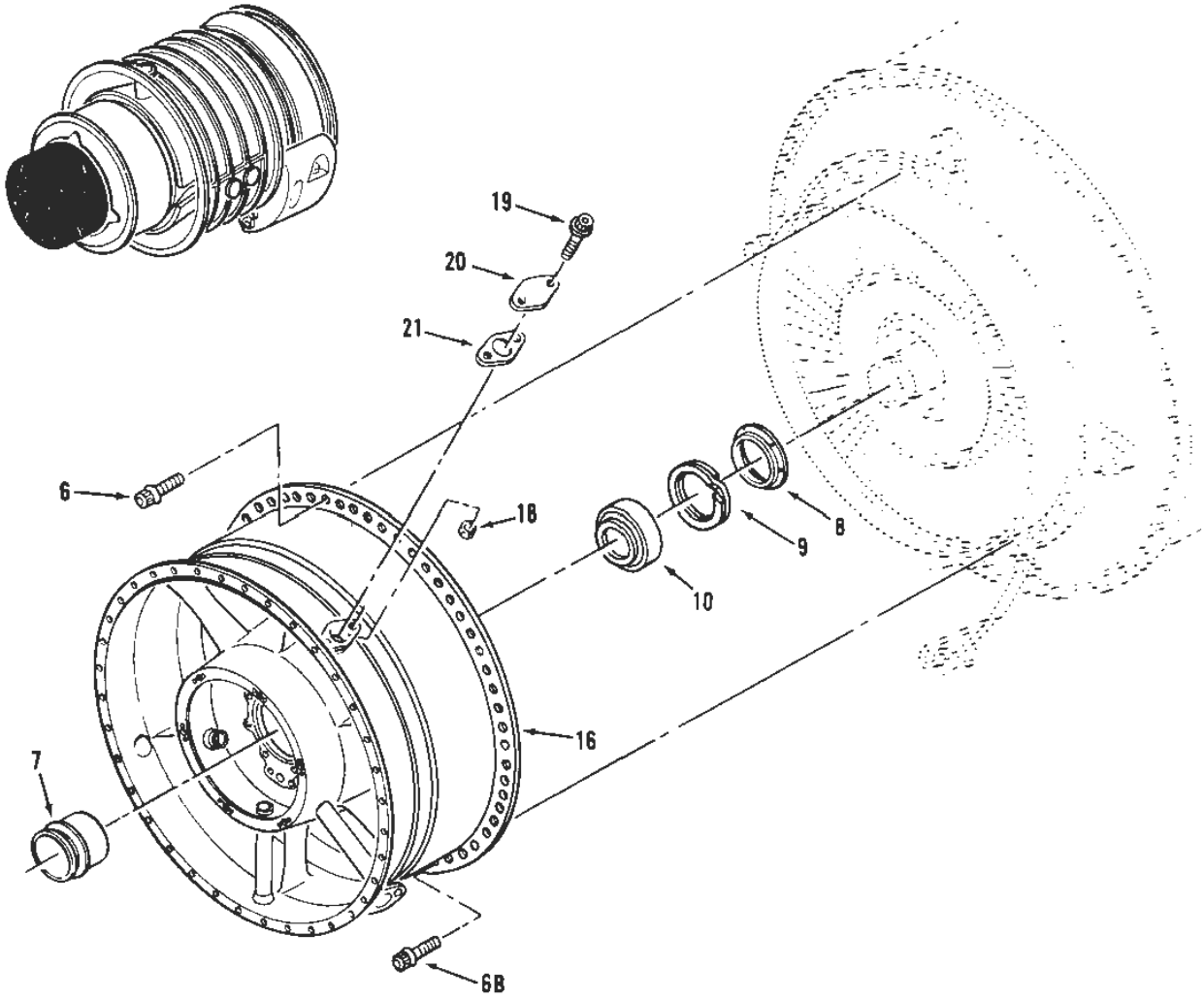
(5) Remove N1 transducer installation in accordance with 77-10-03, MAINTENANCE PRACTICES.

(6) Remove turbine roller bearing in accordance with 72-50-01, MAINTENANCE PRACTICES.

(7) Remove seal rotor using 289751-1 puller.

CAUTION: AFTER REMOVING SEALS IN THE FOLLOWING STEPS, ENSURE TURBINE WHEELS ARE NOT ROTATED UNTIL SEALS ARE REINSTALLED.

(8) Remove mounting brackets and related hardware from forward bolt circle of thrust and exhaust nozzle in accordance with 72-50-03, MAINTENANCE PRACTICES.



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6. BOLT (IPC FIG. 97)
6B. BOLT
7. SEAL ROTOR
8. AIR ROTATING SEAL
9. RETAINING RING
10. NO. 6 AIR-OIL SEAL
16. THRUST AND EXHAUST NOZZLE
*18. NUT (IPC FIG. 98)
*19. BOLT
*20. COVERPLATE
*21. GASKET

*USED ON THRUST AND EXHAUST NOZZLE TYPE WITH PT7 BOSS

Thrust and Exhaust Nozzle Installation
Figure 201

1. A. (9) Remove bolts securing thrust and exhaust nozzle to transition duct

(10) Remove thrust and exhaust nozzle with No. 6 air-oil seal installed as follows.

(a) (Codes A, B) Utilize 289793-1 puller to perform task.

(b) (Code C) Utilize 291928-1 puller to perform task.

(c) Center No. 6 air-oil seal.

(d) Thread jackscrew forward on puller as necessary, and install cup-type pressure pad of puller, exercising caution, through No. 6 air-oil seal. Screw flange portion of puller toward nozzle and secure.

(e) Apply pressure using tee handle (jackscrew action). If nozzle does not disengage with moderate pressure, use a rubber mallet and tap the circumference of the nozzle.

(f) If nozzle still does not disengage (hangs up), heat forward mounting flange of nozzle using a propane torch, and repeat step (e) if necessary.

(g) Remove puller from nozzle.

NOTE: Removal of air rotating seal and No. 6 air-oil seal is not required for removing thrust and exhaust nozzle. Accomplishment of steps (11) through (14) need only be accomplished if replacement of part is required.

(11) If required, remove retaining ring.

(12) If required, remove air rotating seal using 289767-1 puller set and 289767-13 pilot.

(13) If required, remove No. 6 air-oil seal from bore of thrust and exhaust nozzle using 289753-1 driver while
R supporting thrust exhaust nozzle at seal support.

(14) If installed, and if required, remove nuts and bolts securing coverplate and gasket.

1. B. Install Thrust and Exhaust Nozzle (See Figure 201)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) If equipped, and if removed, apply silver goop (anti-seize) to threads of bolts used to secure coverplate. Install gasket and coverplate. Secure with nuts and bolts. Hold nuts and tighten bolts (19) to torque of 40 to 50 inch-pounds.

(2) If removed, install No. 6 air-oil seal in thrust and exhaust nozzle using 289753-1 driver with housing side of seal seated against flange in nozzle (curled edge toward front of engine). Support thrust and exhaust
R nozzle at bearing support using 294920-1 seal install-
R ing support. Ensure dowel pin is not damaged.

(3) If removed, wipe circumference of air rotating seal with solvent, Stoddard (Federal Specification P-D-680, Type I) then, install air rotating seal.

(4) If removed, install retaining ring.

(5) Apply high temperature compound (Fel-Pro C5-A) to threads of bolts. Locate mounting brackets in accordance with 72-50-03, MAINTENANCE PRACTICES. Position thrust and exhaust nozzle on engine, install brackets
R and secure with bolts. Install bolt (6) adjacent to
R ITT thermocouple harness mounting nut. Tighten bolts (6, 6B) sequentially in increments to prevent side-loading to torque of 60 inch-pounds.

(6) Install seal rotor.

(7) Install turbine roller bearing in accordance with 72-50-01, MAINTENANCE PRACTICES.

(8) Install N1 transducer installation (except for transducer access cover plate) in accordance with 77-10-03, MAINTENANCE PRACTICES.

(9) Install rear turbine bearing oil tubes in accordance with 79-20-05, MAINTENANCE PRACTICES.

(10) Install N1 transducer access cover plate in accordance with 77-10-03, MAINTENANCE PRACTICES.

(11) Install oil tube assemblies which connect at bosses on right side and bottom of thrust and exhaust nozzle in accordance with 79-20-04, MAINTENANCE PRACTICES.

1. A. (12) Install hardware securing thermocouple harness and N1 transducer leads in accordance with 72-50-03, MAINTENANCE PRACTICES.

2. Inspection/Check

A. Inspect Seal Rotor

(1) Clean seal rotor in accordance with 3, Cleaning/Painting.

(2) Inspect seal rotor for any unusual metal disturbance (galling spalling, etc). Any pronounced area is not acceptable. Check face and back of rotor for uniform clamping pattern. If any non-uniformity is noted, adjust as required.

(3) Inspect seal rotor for any unusual metal upsetting, such as burrs or foreign particle embedding. If any is observed, inspect adjacent metal parts (shoulder on mating shaft, inner race of bearing (72-50-01)). Replace parts having any unusual metal upsetting.

(4) Inspect seal rotor for circumferential marking or scratches. Light circumferential marking is acceptable. No axial scratches are acceptable.

(5) Replace seal rotor if requirements of steps (1) through (4) are not met.

B. Inspect No. 6 Air-Oil Seal

(1) Inspect carbon ring for the following.

(a) Carbon ring sealing surface wear. Carbon ring sealing surface diameter shall be 1.9732 inch or less as measured at four points 90 degrees apart.

(b) Carbon ring axial sealing surface damage.

1) Visually inspect for nicks and chipping. Nicks or chipping shall not extend, either individually or collectively, across more than ten percent of the axial width of the sealing surface, nor shall they occupy more than one-eighth of the circumference of either the forward or rear edge of the sealing surface.

2) Visually inspect for pits. Pits shall not be larger than 0.030 inch across their longest dimension, nor exceed 0.005 inch in depth. Spacing between adjacent edges of pits shall not be less than 0.100 inch.

2. B. (1) (b) 3) Visually inspect for axial scratches. Axial scratches shall not exceed a depth of 0.001 inch or a width of 0.001 inch, nor a length across more than 30 percent of the axial width of the sealing surface. Spacing between adjacent axial scratches shall not be less than 0.5 inch.

4) Visually inspect for circumferential scratches. Circumferential scratches shall not exceed a depth of 0.001 inch or a width of 0.001 inch. Spacing between adjacent circumferential scratches shall not be less than 0.050 inch. Full circumferential scratches are acceptable, providing they do not connect with axial scratches on forward edge and rear edge. Minimum spacing of circumferential scratches from forward or rear edges shall not be less than 0.060 inch.

(2) Inspect carbon ring of No. 6 air-oil seal for radial response. Carbon ring shall move under very light finger pressure.

(3) Inspect for rotation of end plate. Rotation of end plate is not acceptable.

(4) Visually inspect anti-rotation lug and ensure that it is under center of spring washer crest when looking into seal from bore toward outside diameter. If required, rotate spring washer to required position.

(5) Replace No. 6 air-oil seal if requirements of steps (1) through (4) are not met.

C. Inspect Thrust and Exhaust Nozzle

(1) Inspect thrust and exhaust nozzle for broken welds, cracks, or distortion.

(2) Replace thrust and exhaust nozzle if broken welds, cracks, or distortion is evident.

R (3) Inspect alignment pin on aft face of bearing support
R portion of thrust and exhaust nozzle. (See figure
R 202.) Replace alignment pin if extension above
R machined surface of bearing support is not 0.06 to 0.08
R inch, or if alignment pin is distorted or damaged.
R Refer to 4, Approved Repairs.

3. Cleaning/Painting

Table 203. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Scouring pads (red or green Scotch-Brite)	Minnesota Mining and Manufacturing Co, 3M Center, St. Paul, MN 55101
Solvent, Stoddard (Federal Specification P-D-680, Type I)	Commercially available

A. Clean Parts

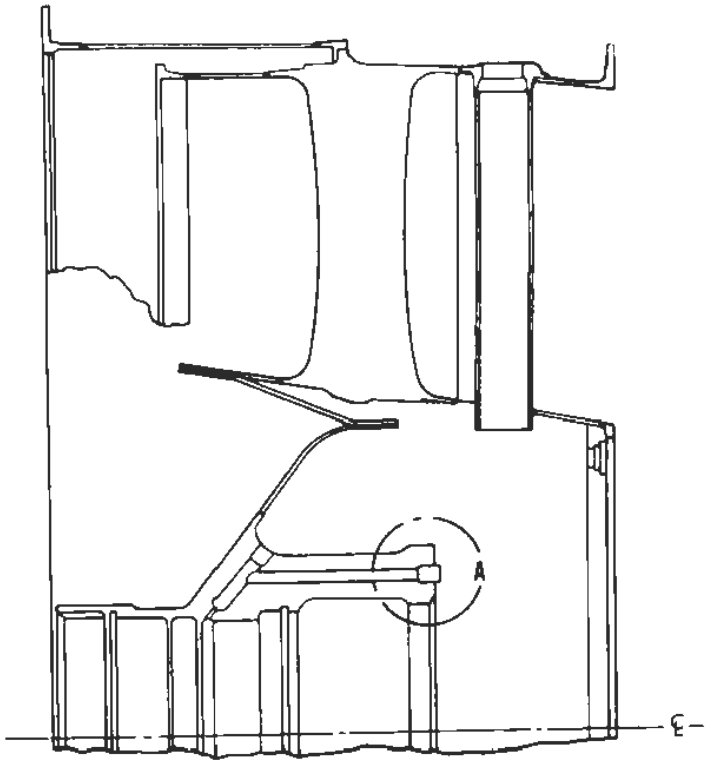
(1) Clean parts as specified in Table 204 in accordance with cleaning methods provided in 72-00-00, GENERAL - CLEANING/PAINTING.

Table 204. Cleaning Methods

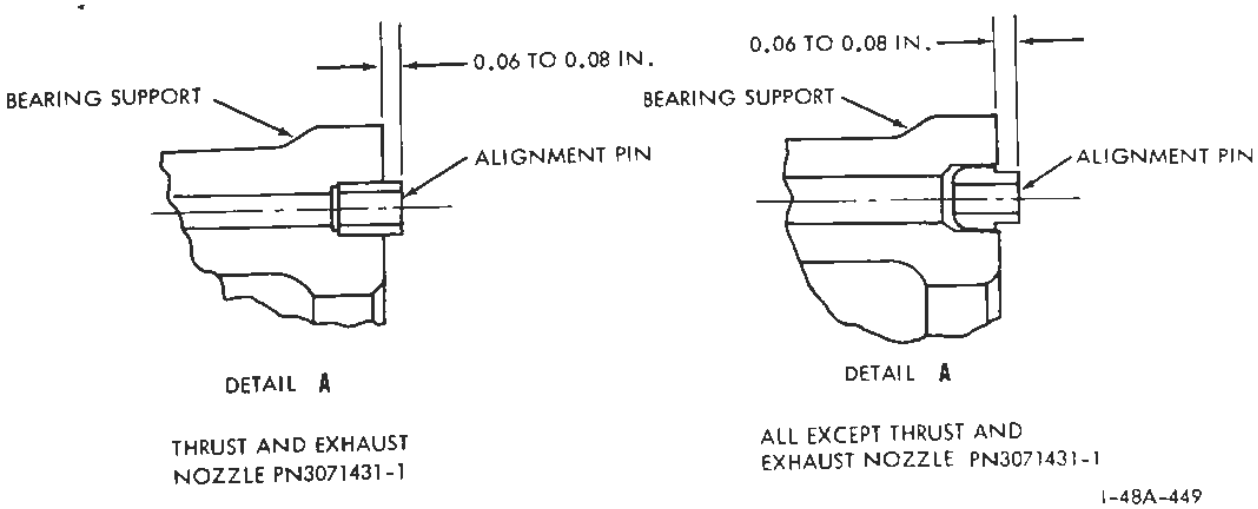
Figure No.	Item No.	Nomenclature	Cleaning Method 1	2	3	4	5	6	7	8	9
All standard metallic hardware			X	X							
201	7	*Seal Rotor	X	X							X
	8	Air Rotating Seal	X	X							X
	9	Retaining Ring	X	X							X
	10	No. 6 Air-Oil Seal	Refer to Specific Cleaning Instructions								
	16	Thrust and Exhaust Nozzle	X	X							

*Refer to step (2) for alternate cleaning procedure.

R



THRUST AND EXHAUST NOZZLE CROSS-SECTION



R Thrust and Exhaust Nozzle Alignment Pin Inspection/Replacement
R Figure 202

3. A. (2) Clean seal rotor (figure 201) using alternate procedure.

CAUTION: WHEN PERFORMING THE FOLLOWING STEP, ENSURE SEAL ROTOR IS FLUSHED THOROUGHLY WHILE SCRUBBING TO PREVENT SCORING FACE OF SEAL ROTOR WITH CARBON PARTICLES.

(a) Scrub seal rotor with scouring pad (red or green Scotch Brite) while flushing with solvent, Stoddard (Federal Specification P-D-680, Type I). Flush seal rotor continuously while scrubbing to wash away carbon particles which may score face of seal rotor.

R 4. Approved Repairs

R A. Replace Damaged Alignment Pin on Thrust and Exhaust Nozzle

R (1) Pull out damaged alignment pin (figure 202) using easy-
R out type tool. Ensure bore for removed pin is clean
R and free of any debris or foreign matter.

R (2) Measure and record hole diameter for alignment pin in
R bearing support of thrust and exhaust nozzle.

R (3) Measure and record nozzle-mating diameter of new
R replacement alignment pin. (For repair of Nozzle, Part
R No. 3071431-1, use Alignment Pin, Part No. 3072890-1.
R For repair of all other nozzle part numbers, use Align-
R ment Pin, Part No. 3072889-1.)

R (4) Subtract hole diameter in nozzle from shoulder diameter
R of pin. If interference fit of 0.0002 to 0.0010 inch
R is measured, replacement pin may be installed. If in-
R terference fit of 0.0002 to 0.0010 inch is not ob-
R tained, return nozzle to a Garrett approved repair cen-
R ter for installation of repair part alignment pin.

R CAUTION: ENSURE HOLE IN NOZZLE FOR ALIGNMENT PIN
R IS FREE OF ALL FOREIGN MATTER AND DEBRIS
R BEFORE INSTALLING NEW ALIGNMENT PIN. ANY
R FOREIGN MATERIAL OR DEBRIS LEFT IN HOLE
R WILL CAUSE FAILURE OF LOW PRESSURE TUR-
R BINE BEARING.

R (5) When interference fit of preceding step is acceptable,
R support nozzle in bearing support area and press in new
R alignment pin to depth indicated (figure 202) (pin ex-
R tending 0.06 to 0.08 inch above machined surface of
R nozzle).

THERMOCOUPLE HARNESS AND N1 TRANDSUCER MOUNTING BRACKETS INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
High temperature compound (Fel-Pro C5-A)	Fel-Pro Inc, Div of Felt Products Mfg Co, 7450 N McCormick Blvd, Skokie, IL 60076
Lubricating compound (Liqui-Moly, Grade NV, Thread Compound)	Lockrey Co, Lubricants Div, Cedar Shores, Southampton, NY 11968

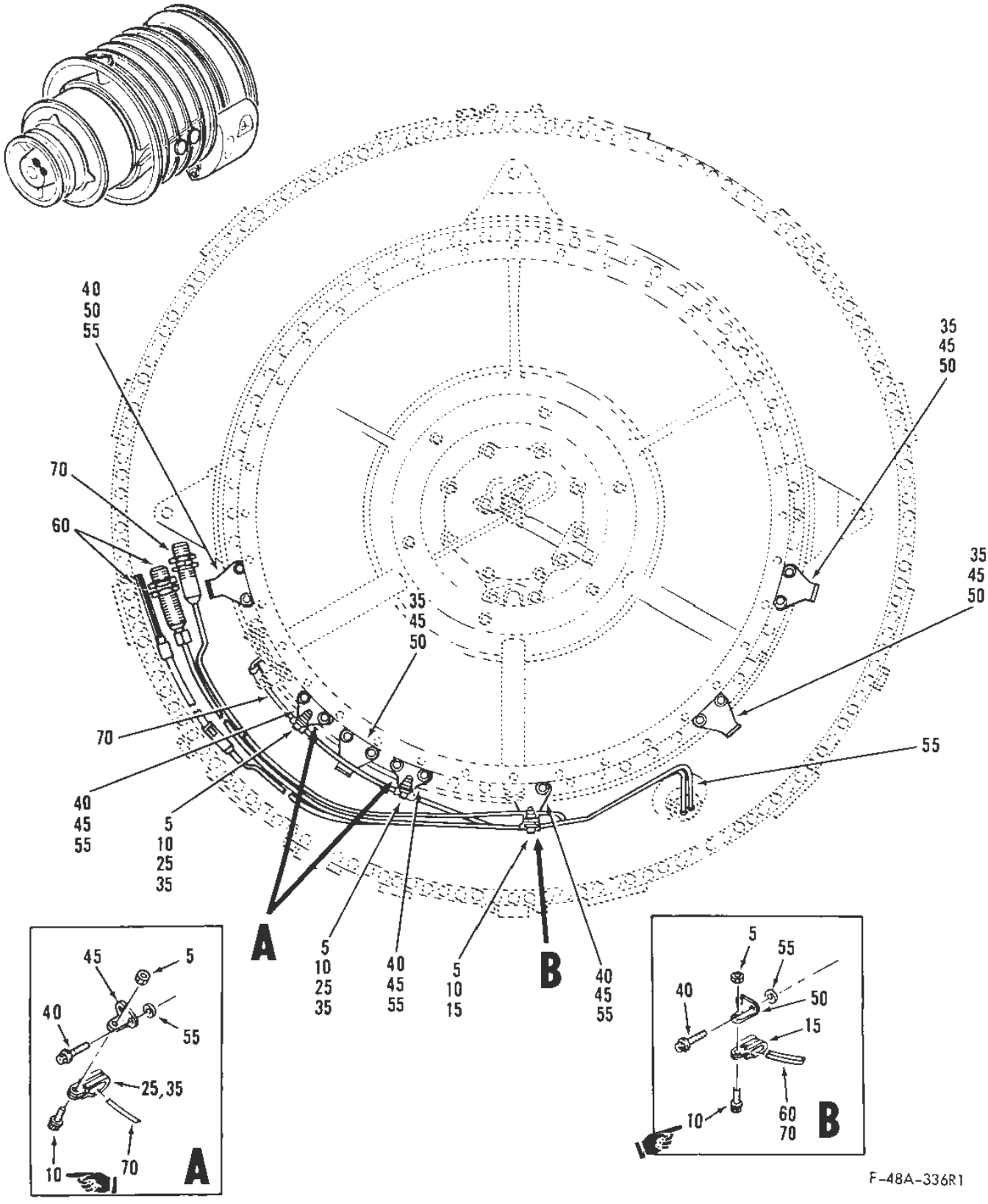
A. Remove Brackets Installation (See Figures 201 through 203, as Applicable)

Disconnect leads and remove nuts, bolts, clamps, brackets, and washers as necessary to perform required maintenance.

B. Install Brackets Installation (See Figures 201 through 203, as Applicable)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) (Codes A, B) Apply high temperature compound (Fel-Pro C5-A) to threads of bolts. Position brackets (details A and B, figure 201) on forward flange of thrust and exhaust nozzle and secure with washers and bolts. Tighten bolts (40) to torque of 60 inch-pounds. Secure leads of thermocouple harness and N1 transducer with clamps, bolts, and nuts. Tighten bolts (10) to torque of 20 inch-pounds. (See figure 201.)



(Codes A, B) Thermocouple Harness and N1 Transducer Mounting Brackets Installation
Figure 201

1. B. (2) (Code C) Apply high temperature compound (Fel-Pro C5-A) to threads of bolts. Position brackets (details A and D, figure 202) on forward flange of thrust and exhaust nozzle and secure with washers and bolts. Tighten bolts (60) to torque of 60 inch-pounds. Position brackets (details B and C, figure 202) on outer flange of turbine interstage transition duct and secure with bolts and nuts. Tighten bolts (45) to torque of 80 inch-pounds. Secure leads of thermocouple harness and N1 transducer with clamps, bolts, and nuts. Tighten bolts (10) to torque of 20 inch-pounds. (See figure 202.)

(3) (Code C) Apply high temperature compound (Fel-Pro C5-A) to threads of bolts. Position fire detector wire brackets (figure 203) on outer flange of turbine interstage transition duct and secure with bolts. Tighten bolts securing brackets (20, 25, 30, figure 203) to torque of 80 inch-pounds.

2. Inspection/Check

A. Perform Inspection/Check

(1) Inspect brackets for bends or cracks. Inspect threaded parts for crossed, galled, or peened threads. Check clamps for worn or missing cushions.

(2) Replace part that does not meet inspection requirements.

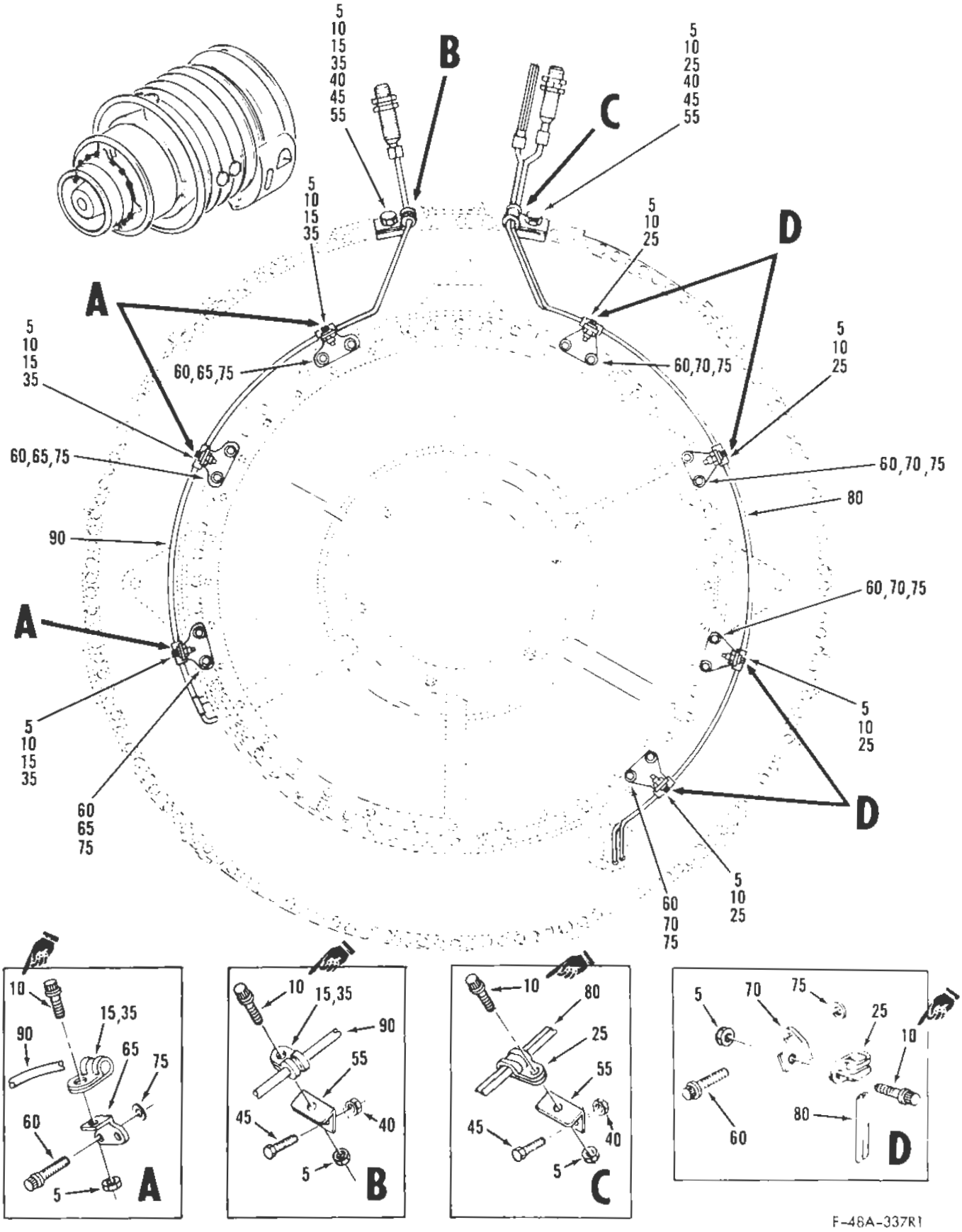
3. Cleaning/Painting

A. Clean Parts

Clean all standard metallic hardware in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method No. 1 or 2.

KEY TO FIGURE 201

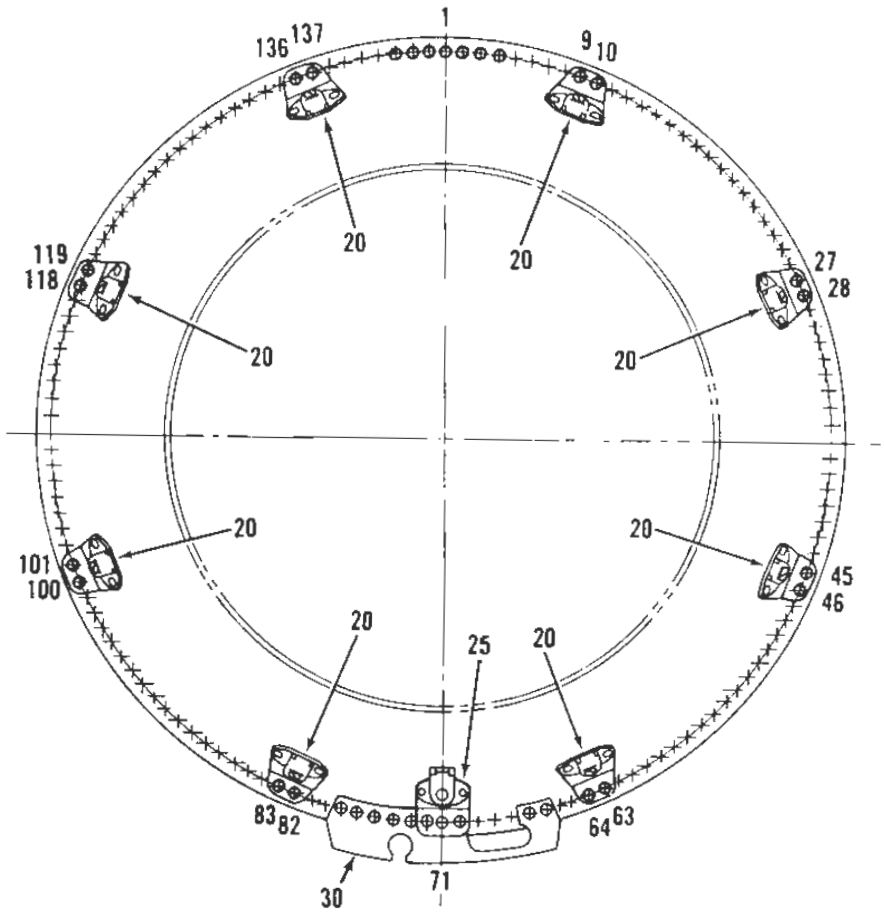
5.	NUT (IPC FIG. 43)	40.	BOLT
10.	BOLT	45.	BRACKET
15.	CLAMP	50.	BRACKET
25.	CLAMP	55.	WASHER
35.	TAPE (NOT USED WITH SMALLER REPLACEMENT CLAMP	60.	THERMOCOUPLE HARNESS
		70.	N1 TRANSDUCER



(Code C) Thermocouple Harness and N1 Transducer Mounting Brackets Installation
Figure 202

KEY TO FIGURE 202

5.	NUT (IPC FIG. 44)	45.	BOLT
10.	BOLT	55.	BRACKET
15.	CLAMP	60.	BOLT
25.	CLAMP	65.	BRACKET
35.	TAPE (NOT USED WITH SMALLER REPLACEMENT CLAMP)	70.	BRACKET
		75.	WASHER
40.	NUT	80.	THERMOCOUPLE HARNESS
		90.	N1 TRANSDUCER



NOTE: VIEWED FROM AFT OF ENGINE LOOKING FORWARD

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20. FIRE DETECTOR WIRE BRACKET (IPC FIG. 11)
25. FIRE DETECTOR WIRE BRACKET (CODE C)
30. MOUNTING BRACKET (REFER TO 79-20-09. MAINTENANCE PRACTICES FOR REMOVAL/INSTALLATION INSTRUCTIONS)

Mounting Brackets Installation
Figure 203

LOW PRESSURE TURBINE MODULE INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Special Tools, Fixtures and Equipment

Item No.	Nomenclature	Use	Source/ Part No.
NOTE:	Equivalent substitutes may be used for listed items.		
R 1. R	Turbine Wheel Mechanical Puller	Facilitates disengagement of turbine wheels.	285845-2-1
2.	Shaft Support and Alignment Fixture (Codes A, B)	Supports tie rod.	289783-1
3.	LP Turbine Module Holder	Supports LP turbine module.	289787-1
4.	Shaft Support and Alignment Fixture (Code C)	Supports tie rod end.	291926-1
5. R R	*Low Pressure Shaft Stretching Fixture (with cylinder and pump)	Stretches tie rod.	291960-1 or 291960-2
6.	*Low Pressure Shaft Stretching Fixture (with cylinder and pump)	Stretches tie shaft.	293003-1 or 293003-2
7.	LP Module Shaft Stretch Gage	Used to measure tie shaft stretch dimension.	293613-1

NOTE: *A fluorescent penetrant inspection in accordance with MIL-I-6866, Type I, on 292374-1 threaded rod and 290489-1 nut of item 5, and on 292041-1 threaded rod and 292042-1 nut of item 6, is required to ensure serviceability at 60 day intervals or after each 100 times fixture is loaded (whichever occurs first). Maintain a permanent record with stretching fixture to record number and dates of fixture loading and dates of inspection. Life limit of 292374-1 threaded rod and 290489-1 nut is 6,000 fixture loadings. These components shall be replaced at or before reaching life limit.

Table 202. Materials and Compounds

Material or Compound	Manufacturer
CAUTION: ANY SUBSTITUTES USED FOR LISTED INDUSTRIAL MARKING INK OR YELLOW CHINA MARKER SHALL CONTAIN NO CARBON.	
NOTE: Equivalent substitutes may be used for listed items.	
High temperature compound (Fel-Pro C5-A)	Fel-Pro Inc, Div of Felt Products Mfg Co, 7450 N McCormick Blvd, Skokie, IL 60076
Industrial marking ink (Violet, No. 127-1/2)	Pannier Corp, 207 Sandusky St, Pittsburgh, PA 15212
Lubricating compound (Liqui-Moly, Grade NV, thread compound)	Lockrey Co, Lubricants Div, Cedar Shores, Southampton, NY 11968
Yellow china marker (No. 170T)	Blaisdell Pencil Co, Philmont Rd, Bethagres, PA 19006

1. A. Remove LP Turbine Module (See Figure 201)

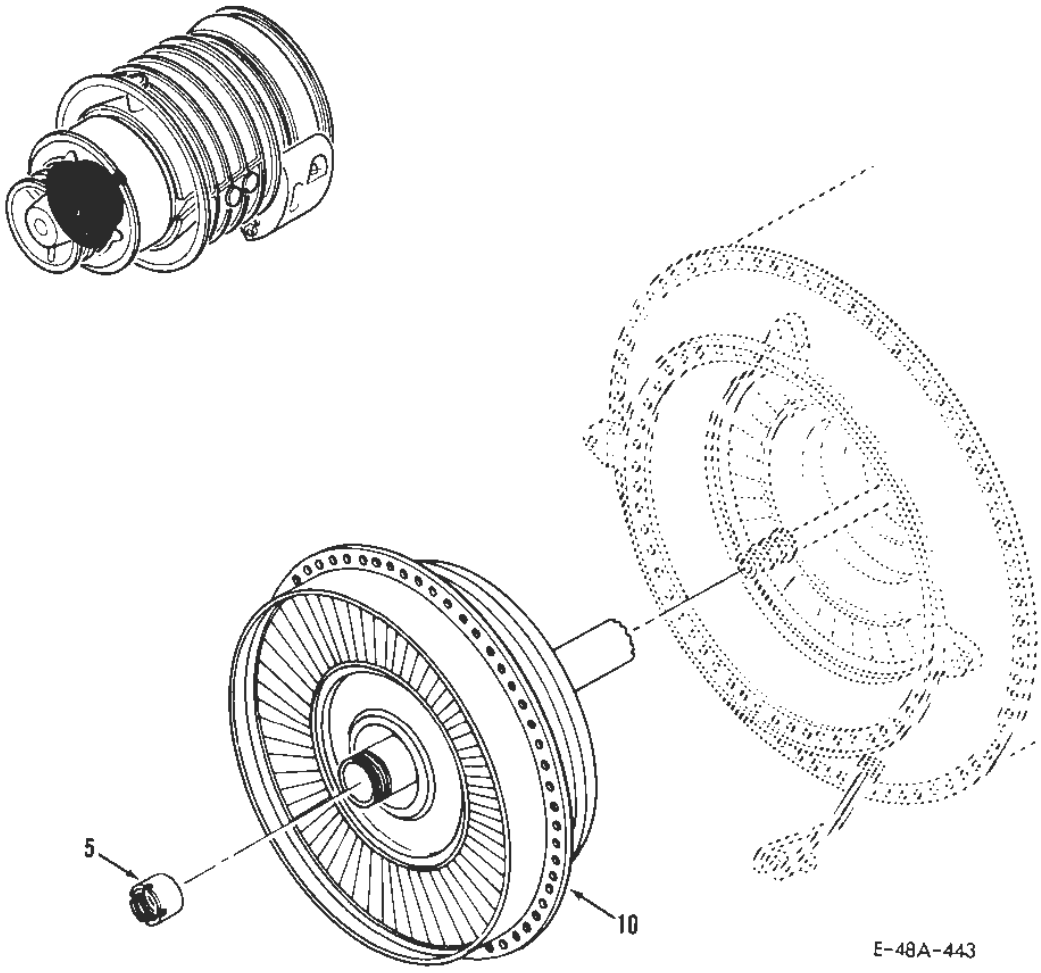
   (1) Remove oil tube assemblies connected at bosses on right side and bottom of thrust and exhaust nozzle in accordance with 79-20-04, MAINTENANCE PRACTICES.

   (2) Remove N1 transducer access cover plate in accordance with 77-10-03, MAINTENANCE PRACTICES.

   (3) Remove rear turbine bearing oil tube in accordance with 79-20-05, MAINTENANCE PRACTICES.

   (4) Remove hardware securing thermocouple harness and N1 transducer leads in accordance with 72-50-03, MAINTENANCE PRACTICES.

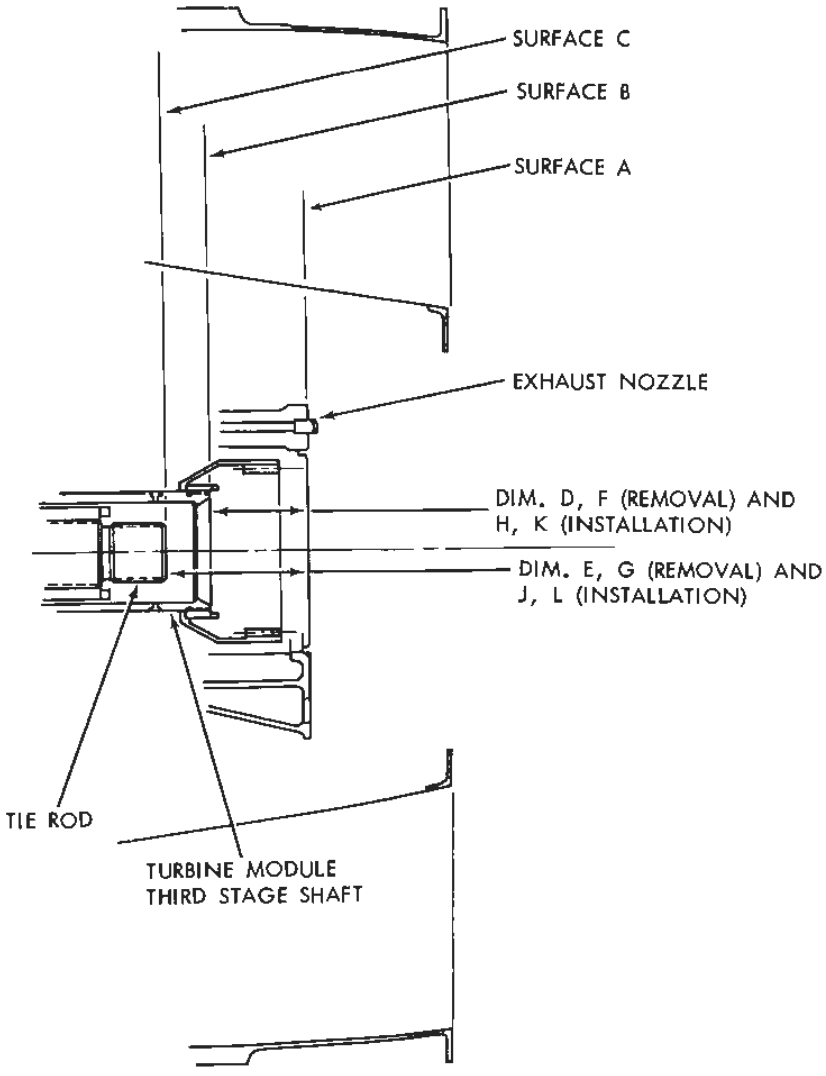
   (5) Remove N1 transducer installation in accordance with 77-10-03, MAINTENANCE PRACTICES.



5. TIE ROD NUT
(IPC FIG. 99)

10. LOW PRESSURE TURBINE
ASSY (MODULE)

Low Pressure Turbine Module Installation
Figure 201



I-48A-211

Curvic Coupling Teeth Alignment Check
Figure 202

NOTE: Removal of low pressure tie rod nut requires a vibration check after re-installation. Refer to 72-00-00, GENERAL - ADJUSTMENT/TEST, paragraph 12.

1. A. (6) Mark relative positions of shaft on turbine module and tie rod with yellow china marker (No. 170T) or industrial marking ink (Violet, No. 127-1/2) to aid reassembly.

NOTE: Dimensions and respective positions recorded in the following steps are for use at reassembly of the low pressure turbine module to ensure correct tie rod stretch and radial alignment of curvic coupling teeth.

Hand load the turbine module forward (with approximately 15 pounds of force) during all dimensional measurements.

(7) Measure and record Dimension D (on work sheet of Table 203) from Surface A on thrust and exhaust nozzle to Surface B on turbine module third stage shaft. (See figure 202.) Mark points used for measurement using yellow china marker (No. 170T) or industrial marking ink (Violet, No. 127-1/2).

(8) Measure and record Dimension E (on work sheet of Table 203) from Surface A on thrust and exhaust nozzle to Surface C on end of tie rod. (See figure 202.) Mark points used for measurement using yellow china marker (No. 170T) or industrial marking ink (Violet, No. 127-1/2).

Table 203. Tie Rod Stretch andCurvic Coupling Radial Alignment Worksheet

Date: _____ Engine Serial No. _____ Technician: _____

Para. Ref	Dimensions to be Recorded (Fig. 202)	Surfaces Measurement (Fig. 202)	Conditions
LP Turbine Removal			
1.A.(7)	Dim. D:____	A to B	Tie rod stretched.
1.A.(8)	Dim. E:____	A to C	Tie rod stretched.
1.A.(10)	Dim. F:____	A to B	Tie rod unstretched (tie rod nut hand tight).
1.A.(11)	Dim. G:____	A to C	Tie rod unstretched (tie rod nut hand tight).
LP Turbine Installation			
1.D.(6)	Dim. H:____	A to B	Tie rod unstretched (tie rod nut hand tight). Dimension H shall equal Dimension F, +0.015/ -0.015* inch.
1.D.(7)	Dim. J:____	A to C	Tie rod unstretched (tie rod nut hand tight). Dimension J, shall equal Dimension G, +0.015/ -0.015* inch.
R 1.D.(10)	Dim. K:____	A to B	Tie rod stretched.
R 1.D.(11)	Dim. L:____	A to C	Tie rod stretched.

NOTE: *If components other than those removed are installed, use tolerance of 0.030 inch instead of 0.015 inch for dimension comparison.

Keep worksheets for each LP turbine removal/installation performed with permanent engine records.

WARNING: DO NOT STAND BEHIND, ABOVE, OR BELOW SHAFT STRETCH FIXTURE WHEN PRESSURE IS APPLIED TO FIXTURE IN THE FOLLOWING STEPS. A FAILURE OF FIXTURE OR ENGINE TIE ROD WOULD EXPEL FIXTURE AFT WITH CONSIDERABLE FORCE.

CAUTION: WHEN PERFORMING THE FOLLOWING PROCEDURE, MAKE CERTAIN FORCE SPECIFIED IS NOT EXCEEDED TO ENSURE SHAFT IS NOT OVERSTRETCHED. ENSURE PROPER SPECIAL TOOLING IS USED.

ROD PORTION OF SHAFT STRETCH FIXTURE MUST BE INSTALLED AND POSITIONED AS DESCRIBED IN THE FOLLOWING STEPS PRIOR TO APPLICATION OF PRESSURE TO FIXTURE TO AVOID LOCKING ROD AGAINST NUT.

R 1. A. (9) Loosen tie rod nut as follows using 291960-1 or 291960-2 fixture.

(a) Disassemble 291960-1 or 291960-2 fixture to separate threaded rod and wrench. Clean threads of fixture components and mating threads for fixture on engine component. Lubricate threads on threaded rod of fixture with a light coat of lubricating compound (Liqui-Moly, Grade NV, thread compound). Install brass nut of fixture onto exposed threads of third stage shaft to protect threads during stretch of tie rod in the following steps. Install brass nut to depth that positions aft face of nut 0.010 to 0.030 inch forward of end of third stage shaft.

NOTE: Steps (b) through (e) are performed to ensure maximum thread engagement of fixture rod and tie rod before final positioning of fixture rod and applying hydraulic pressure to fixture.

(b) Apply a small amount of lubricating compound (Liqui-Moly, Grade NV, thread compound) to face of fixture rod which will contact aft face of tie rod nut when rod is bottomed.

(c) Thread fixture rod onto exposed threads of tie rod until fixture rod bottoms against aft face of tie rod nut. Make reference mark on end of fixture rod to aid counting turns, then back fixture rod out, counting turns required to remove rod. Note number of turns required.

(d) Inspect aft face of tie rod nut to ensure presence of lubricating compound (Liqui-Moly, Grade NV,

thread compound). Presence of lubricating compound (Liqui-Moly, Grade NV, thread compound) indicates full engagement of fixture rod with tie rod nut when rod is threaded onto tie rod with number of turns noted in previous step.

CAUTION: A MINIMUM NUMBER OF NINE AND ONE-FOURTH THREADS SHALL BE ENGAGED WHEN PERFORMING THE FOLLOWING STEP. IF LESS THAN NINE AND ONE-FOURTH TURNS ARE COUNTED WHEN REMOVING FIXTURE ROD, DO NOT CONTINUE PROCEDURE.

1. A. (9) (e) Thread fixture rod onto exposed threads of tie rod to bottoming position, ensuring same number of threads are engaged as noted in step (c).

CAUTION: BACKING FIXTURE ROD OUT FROM BOTTOMING POSITION MORE THAN TWO AND ONE-FOURTH TURNS IN THE FOLLOWING STEP MAY NOT PROVIDE SUFFICIENT THREAD ENGAGEMENT AND CAUSE FAILURE OF TIE ROD OR FIXTURE.

(f) Hold rotating group of engine stationary with hand and back rod out two and one-fourth turns to ensure tie rod nut can be loosened when pressure is applied to fixture.

(g) Slide wrench portion of fixture forward over fixture rod to engage tie rod nut.

(h) Carefully assemble adapter and cylinder assembly of fixture over rod. Secure assembly with fixture bushing and wing nut on end of rod, holding fixture forward against third stage shaft of turbine module. Install bushing and wing nut to bottoming position, then back wing nut out one and one-half turns. Ensure rod does not turn with wing nut.

(i) Use hand pressure to align cylinder assembly of fixture concentrically with fixture rod, then apply sufficient pressure with hydraulic pump of fixture to support cylinder in aligned position.

R (j) (Post SB72-3119) Slowly continue to apply pressure with hydraulic pump of fixture until fixture
R pressure gage indicated 4400 psig.

R (j1) (Pre SB72-3119) Slowly continue to apply pressure
R with hydraulic pump of fixture until fixture pres-
R sure gage indicates 5550 psig.

CAUTION: WHEN REQUIRED TO INCREASE HYDRAULIC PRESSURE ON FIXTURE AS SPECIFIED IN THE FOLLOWING STEP, DO NOT EXCEED MAXIMUM PRESSURE SPECIFIED ON FIXTURE.

1. A. (9) (k) Turn fixture wrench to rotate tie rod nut counterclockwise. If tie rod nut will not loosen, relieve hydraulic pressure on fixture and repeat steps (i) through (k) to loosen nut. If tie rod nut will not loosen after four repetitions, repeat steps (i) through (k) with hydraulic pressure increased 50 psig over previously used hydraulic pressure. Continue repetitions until tie rod nut is loosened, but do not exceed maximum hydraulic pressure specified on fixture.

(l) Turn fixture wrench to rotate tie rod nut counterclockwise until tie rod nut bottoms against rod of fixture, then rotate tie rod nut one-half turn clockwise.

(m) Slowly relieve hydraulic pressure, then remove fixture.

NOTE: Hand load the turbine module forward (with approximately 15 pounds of force) during all dimensional measurements.

(10) Measure and record Dimension F (on work sheet of Table 203) from Surface A on thrust and exhaust nozzle to Surface B on turbine module third stage shaft. (See figure 202.) Ensure measurement is taken from points marked during initial measurement.

(11) Measure and record Dimension G (on work sheet of Table 203) from Surface A on thrust and exhaust nozzle to Surface C on tie rod. (See figure 202.) Ensure measurement is taken from points marked during initial measurement.

(12) Remove low pressure turbine roller bearing in accordance with 72-50-01, MAINTENANCE PRACTICES.

R (13) Remove thrust and exhaust nozzle in accordance with steps 1.A.(7) through 1.A.(10) only, 72-50-02, MAINTENANCE PRACTICES.

NOTE: A record of cycles as specified in Service Bulletin 72-3001 shall be maintained on selected rotating parts within the low pressure turbine module throughout life of parts.

1. A. (14) Mark relative position of low pressure turbine module with yellow china marker (No. 170T), or industrial marking ink (Violet, No. 127-1/2) to aid in reassembly.

NOTE: LP turbine module weighs approximately 75 pounds.

(15) Remove tie rod nut. Remove low pressure turbine module.

NOTE: 289783-1 or 291926-1 fixture supports tie rod until low pressure turbine module is reinstalled.

(16) (Codes A, B) Install 289783-1 fixture on turbine interstage transition duct.

(17) (Code C) Install 291926-1 fixture on turbine interstage transition duct.

B. Disassembly Low Pressure Turbine Assembly (See Figure 203)

CAUTION: USE CARE WHEN HANDLING COMPONENTS WITH CURVIC COUPLINGS AND KNIFE EDGE SEALS TO AVOID DAMAGE. REFER TO 70-00-00, 6, COMPONENT HANDLING.

(1) Install shoulder plug of 293613-1 gage in bore of 289787-1 holder. Install module on shouldered plug with shaft end of module up.

(2) Install cylindrical shaft, gage rod, and sleeve of 293613-1 gage into shaft end of module. Rotate gage to align slot in gage with cross of key inside tie shaft and seat gage rod on ball in shouldered plug.

(3) Measure and record dimension from surface of cylindrical shaft to top of gage rod. Record as Dimension A (figure 204) on data sheet (table 204).

(4) Measure and record dimension from surface of cylindrical shaft to top surface of curvic coupling teeth on shaft and seal assembly. Record as Dimension B (figure 204) on data sheet (table 204).

1. B. (5) Subtract Dimension A from Dimension B. Record result as Reference Stretched Curvic Coupling Dimension on data sheet (table 204) for use at reassembly.

(6) Remove components of 293613-1 gage and reinstall module on 289787-1 holder.

(7) Straighten tab of forward key out of slot in nut.

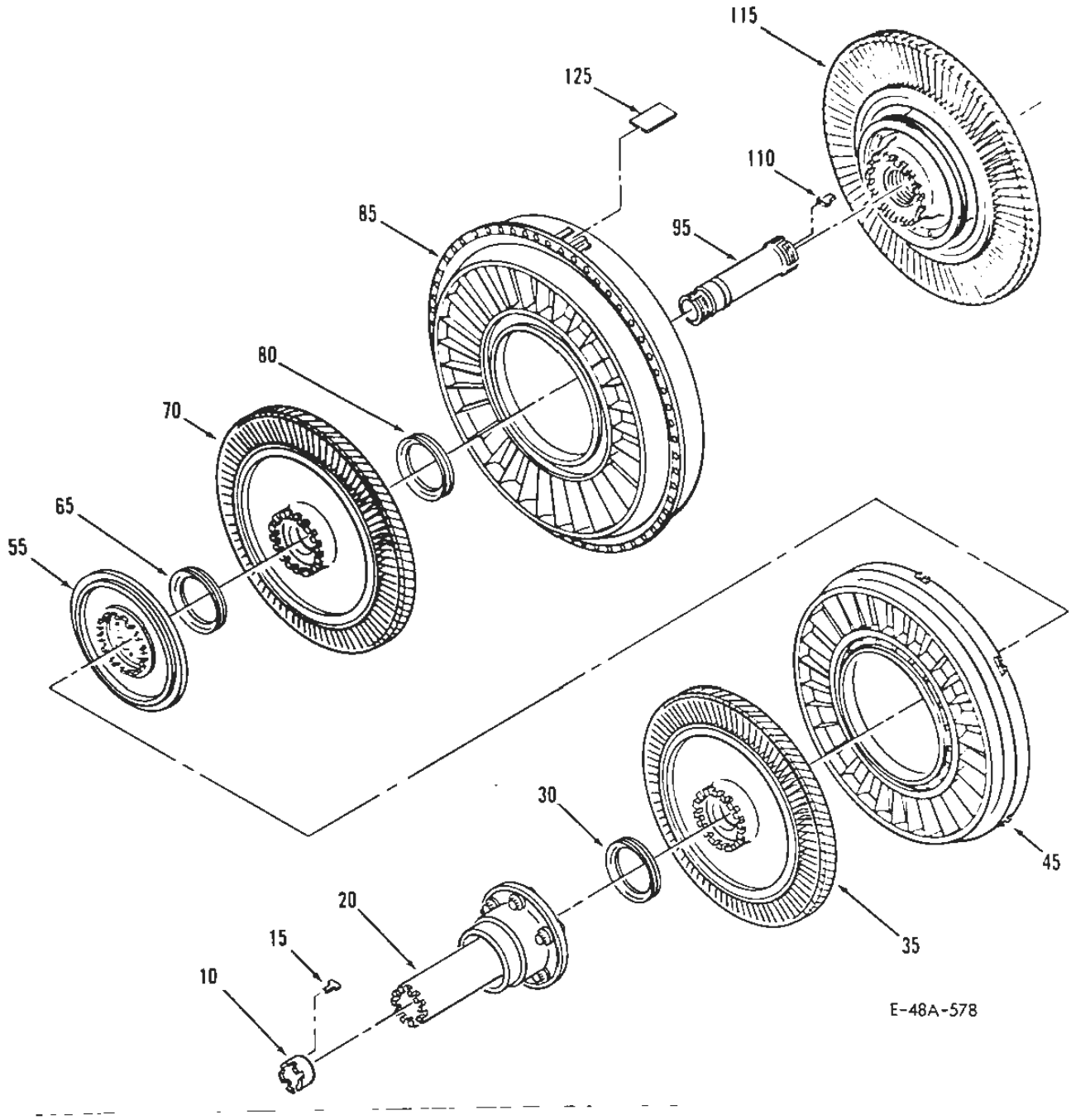
(8) Loosen nut as follows.

WARNING: DO NOT STAND ABOVE, BEHIND, OR BELOW SHAFT STRETCH FIXTURE WHEN PRESSURE IS APPLIED TO FIXTURE IN THE FOLLOWING STEPS. A FAILURE OF FIXTURE OR TIE SHAFT WOULD EXPEL FIXTURE FROM SHAFT WITH CONSIDERABLE FORCE.

CAUTION: WHEN PERFORMING THE FOLLOWING PROCEDURE. MAKE CERTAIN FORCE SPECIFIED IS NOT EXCEEDED TO ENSURE TIE SHAFT IS NOT OVERSTRETCHED. ENSURE 293003-1 OR 293003-2 FIXTURE IS USED. USE OF SHAFT STRETCH FIXTURE OTHER THAN PART NO. 293003-1 OR 293003-2 MAY OVERSTRETCH SHAFT OR NOT PROVIDE SUFFICIENT STRETCH AT PRESSURES SPECIFIED.

NOTE: When performing the following step, ensure large wing nut on shaft stretch fixture does not bottom on fixture until expanding collet is properly engaged in tie shaft.

R (a) Clean threads of 293003-1 or 293003-2 fixture components and mating threads for fixture on engine component. Lubricate threads on threaded rod of fixture with a light coat of lubricating compound (Liqui-Moly, Grade NV, thread compound). Install expanding collet of fixture into internal diameter of tie shaft. Turn small wing nut on fixture (to expand collet and engage internal shoulder of tie shaft) until collet is tight inside shaft, then turn counterclockwise until collet is free to move.



10.	SHAFT NUT (IPC FIG. 100)	45.	SECOND STAGE TURBINE NOZZLE	85.	THIRD STAGE TURBINE NOZZLE
15.	NUT LOCKING KEY (FWD)	55.	ROTATING SEAL	95.	TIE SHAFT
20.	SHAFT AND SEAL ASSY	65.	CENTER SEAL RING	110.	NUT LOCKING KEY (AFT)
30.	FORWARD SEAL RING	70.	SECOND STAGE TURBINE ROTOR ASSY	115.	THIRD STAGE TURBINE
35.	FIRST STAGE TURBINE ROTOR ASSY	80.	AFT SEAL RING	125.	NAMEPLATE

R

Low Pressure Turbine Assembly
Figure 203

1. B. (8) (b) Secure hydraulic cylinder and adapter of 293003-1 or 293003-2 fixture against taper of shaft and seal assembly with large wing nut of fixture. Install large wing nut to bottoming position, then back out large wing nut two turns.

(c) Use hand pressure to align cylinder of fixture concentrically with expanding collet shaft, then apply sufficient pressure with hydraulic pump of fixture to support cylinder in aligned position.

CAUTION: WHEN REQUIRED TO INCREASE HYDRAULIC PRESSURE ON FIXTURE AS SPECIFIED IN THE FOLLOWING STEP, DO NOT EXCEED MAXIMUM HYDRAULIC PRESSURE SPECIFIED ON FIXTURE.

1. B. (8) (d) Slowly continue to increase hydraulic pressure with hydraulic pump of fixture until fixture pressure gage indicates 2300 psig.

CAUTION: WHEN REQUIRED TO INCREASE HYDRAULIC PRESSURE ON FIXTURE AS SPECIFIED IN THE FOLLOWING STEP, DO NOT EXCEED MAXIMUM HYDRAULIC PRESSURE SPECIFIED ON FIXTURE.

(e) Apply hand pressure to turn fixture wrench counterclockwise and loosen nut. If required, slowly increase hydraulic pressure with fixture pump until nut may be loosened with hand pressure. If hydraulic pressure is increased to maximum value specified on fixture and nut still will not loosen, reduce hydraulic pressure to 1500 psig and repeat this step. Do not exceed maximum hydraulic pressure specified on fixture. Loosen nut three turns.

(f) Slowly relieve hydraulic pressure on fixture and remove fixture.

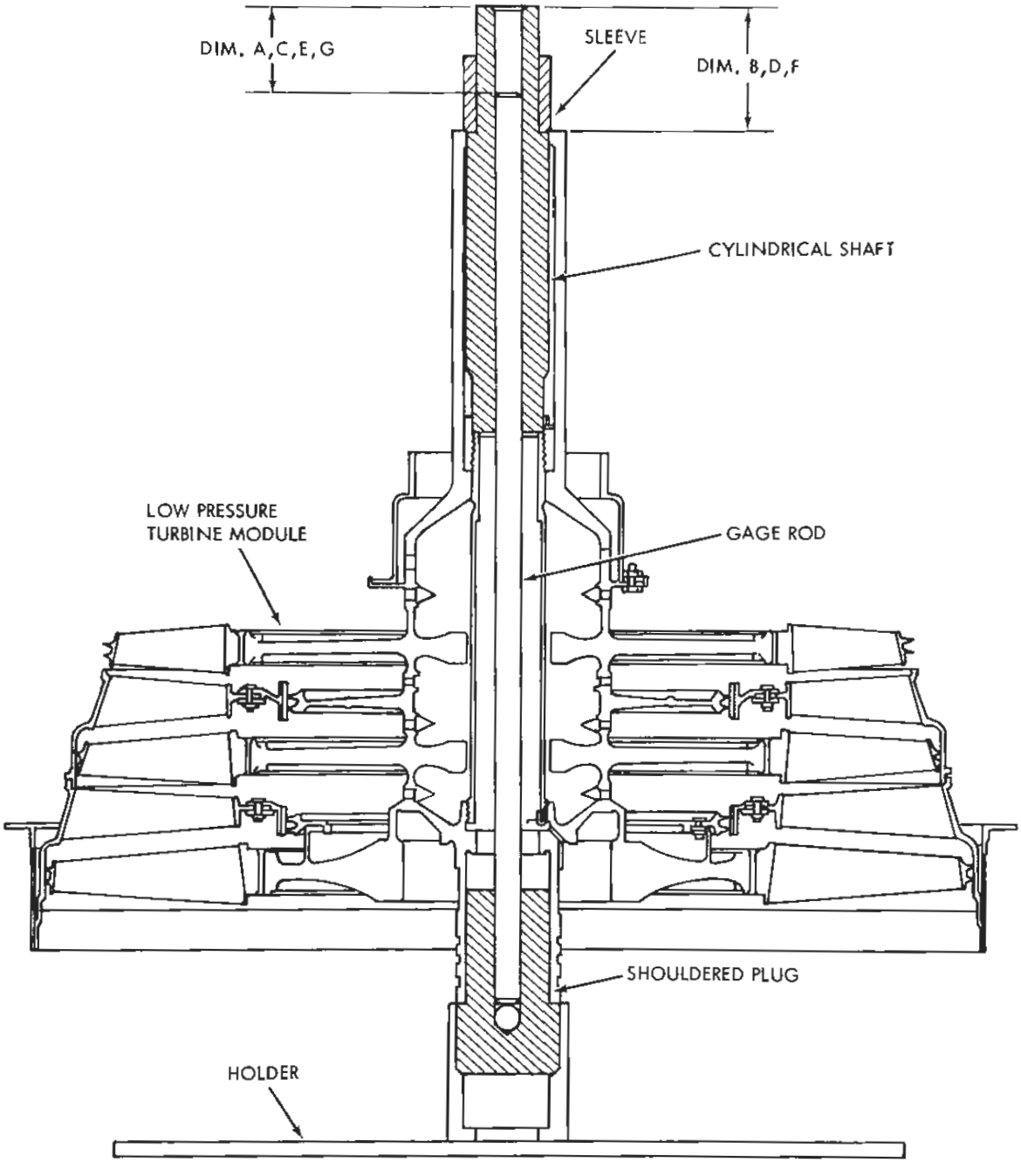
NOTE: Before proceeding, ensure nut on tie shaft is threaded onto tie shaft far enough that nut will not interfere with seating of cylindrical shaft of 293613-1 gage on end of tie shaft.

(9) Install shouldered plug of 293613-1 gage in bore of 289787-1 holder. Install module on shouldered plug.

(10) Install cylindrical shaft, gage rod, and sleeve of 293613-1 gage into shaft end of module. Rotate gage to align slot in gage with cross of key inside tie shaft and seat gage rod on ball in shouldered plug.

(11) Measure and record dimension from surface of cylindrical shaft to top of gage rod. Record as Dimension C (figure 204) on data sheet (table 204).

(12) Measure and record dimension from surface of cylindrical shaft to top surface of curvic coupling teeth on shaft and seal assembly. Record as Dimension D (figure 204) on data sheet (table 204).



Measurements for Shaft Stretch and Curvic Teeth Alignment on Low Pressure Turbine Module
Figure 204

1. B. (13) Subtract Dimension C from Dimension D. Record result as Reference Unstretched Curvic Coupling Dimension on data sheet (table 204) for use at reassembly.

(14) Remove shaft nut.

Table 204. LP Turbine Module Disassembly/Assembly Data Sheet

Para. Ref	Dimension (Figure 204) or Calculation	Result
1.B.(3)	Surface of cylindrical shaft to top surface or gage rod (Dimension A):	_____in.
1.B.(4)	Surface of cylindrical shaft to top surface of curvic coupling teeth on shaft and seal assembly (Dimension B):	_____in.
1.B.(5)	Dimension B - Dimension A = Stretched Curvic Coupling Dimension:	_____in.
1.B.(11)	Surface of cylindrical shaft to top of gage rod (Dimension C):	_____in.
1.B.(12)	Surface of cylindrical shaft to top surface of curvic coupling teeth on shaft and seal assembly (Dimension D):	_____in.
1.B.(13)	Dimension D - Dimension C = Unstretched Curvic Coupling Dimension:	_____in.
1.C.(1)(o)	Surface of cylindrical shaft to top surface of gage rod (Dimension E, Zero Stretch Dimension):	_____in.
1.C.(1)(p)	Surface of cylindrical shaft to top surface of curvic coupling teeth on shaft and seal assembly (Dimension F):	_____in.

Table 204. LP Turbine Module Disassembly/Assembly Data Sheet (Cont)

Para. Ref	Dimension (Figure 204) or Calculation	Result
1.C.(1)(q)	Dimension F - Dimension E:	_____in.
	Difference of result (Dimension F - Dimension E) and Reference Unstretched Curvic Coupling Dimension (step 1.B.(13)):	_____in.
	(Difference shall not exceed 0.004 inch (same rotating parts installed) or 0.024 inch (one or more replacement rotating parts installed).)	
1.C.(2)(i)	Surface of cylindrical shaft to top of gage rod (Dimension G, Shaft Stretch Dimension):	_____in.
1.C.(2)(j)	Shaft Stretch Dimension (step 1.C.(2)(i) - Zero Stretch Dimension (step 1.C.(1)(n)):	_____in.
	(Difference shall be 0.0076 to 0.0096 inch.)	

NOTE: Index relative positions of components before and during disassembly using yellow china marker (No. 170T) or industrial marking ink (Violet, No. 127-1/2) to aid reassembly.

1. B. (15) Remove shaft and seal assembly and forward seal ring. Remove forward nut locking keys from slots in tie shaft.

NOTE: A record of cycles, as specified in Service Bulletin 72-3001, shall be maintained on discs of first, second, and third stage rotor assemblies and on rotating seal throughout life of parts.

R If curvic couplings of rotating components will not disengage when performing the following step a propane torch may be used to heat curvic couplings and facilitate disengagement. Apply heat to internal side of coupling at one point only, then allow to cool.

R 1. B. (16) Remove first stage turbine rotor assembly, second stage turbine nozzle, rotating seal, center seal ring, and second stage turbine rotor assembly. If curvic couplings of components will not disengage manually, or by application of heat, use 285845-2-1 mechanical turbine wheel puller as follows.

CAUTION: WHEN PERFORMING THE FOLLOWING STEPS ENSURE PROTECTIVE COVER OVER FORWARD CURVIC COUPLING OF FIRST STAGE TURBINE ROTOR ASSEMBLY REMAINS IN PLACE TO AVOID DAMAGE.

(a) Install protective cover over forward curvic coupling on first stage turbine rotor assembly. Remove assembled first stage turbine rotor assembly, second stage turbine nozzle, rotating seal, center seal ring, and second stage turbine rotor assembly and place on work bench with first stage turbine rotor assembly face down ensuring protective cover on curvic coupling is in place.

(b) With legs of 285845-2-1 mechanical turbine wheel puller squeezed together using hand pressure, insert tool through second stage turbine assembly hub bore until lips at bottom of legs are in cavity between first and second stage turbine rotor assemblies. Release hand pressure on legs of puller to position lips on bottom of legs on both rotor hub bore shoulders.

R 1. B. (16) (c) Turn jackscrew on puller clockwise until curvic
R couplings disengage. Squeeze legs of puller
R together using hand pressure and remove puller.

R (d) Remove second stage turbine rotor assembly, center
R seal ring, rotating seal, and second stage turbine
R nozzle.

R (17) Remove aft seal ring and third stage turbine nozzle.

NOTE: Removal of tie shaft from third stage
R turbine rotor assembly (steps (18) and (19)) is not necessary unless required for parts replacement.

(18) Straighten tab of aft nut locking key out of slot in third stage turbine rotor assembly.

(19) Unthread tie shaft from third stage turbine rotor assembly and remove aft nut locking key from tie shaft.

C. Assemble LP Turbine Module (See Figure 203)

(1) Assemble components.

CAUTION: ENGINE LOG BOOK (LIFE LIMITED PART LOG) SPECIFIES AMOUNT OF MATERIAL REMOVED FROM BLADES OF EACH ROTOR ASSEMBLY SINCE ROTOR ASSEMBLY WAS LAST BALANCED. ADD VALUES LISTED FOR THREE ROTOR ASSEMBLIES. IF TOTAL IS GREATER THAN 0.0375 SQUARE INCH, BALANCING IS REQUIRED FOR ONE OR MORE ROTOR ASSEMBLIES TO ENSURE ROTATING GROUP IS SUFFICIENTLY BALANCED. REFER TO 4, APPROVED REPAIRS.

USE CARE WHEN HANDLING COMPONENTS WITH CURVIC COUPLINGS AND KNIFE EDGE SEALS TO AVOID DAMAGE. REFER TO 70-00-00, 6, COMPONENT HANDLING.

(a) Place third stage turbine rotor assembly in 289787-1 holder with shaft portion down.

NOTE: The following step is required only when tie shaft has been removed from the third stage turbine rotor assembly.

1. C. (1) (b) Position new aft nut locking key with cross inside tie shaft, then bend tab of aft nut locking key into slot in external threads of tie shaft. Coat threads of tie shaft with high temperature compound (Fel-Pro C5-A) and install tie shaft fully into third stage turbine rotor assembly. Count number of turns required to bottom tie shaft. Seven turns or more indicates tie shaft is fully bottomed. Back tie shaft out one and one-half or two turns from bottom position and lock position by bending tab of aft nut locking key into slot in third stage turbine rotor assembly.

CAUTION: WHEN INSTALLING SECOND STAGE TURBINE ROTOR ASSEMBLY IN THE FOLLOWING STEP, USE CARE NOT TO INSTALL ROTOR ASSEMBLY FACING WRONG DIRECTION. SIDE STAMPED AFT MUST FACE THIRD STAGE TURBINE ROTOR ASSEMBLY. AIRFOIL TRAILING (AFT) EDGE OF BLADES IS SLIGHTLY LONGER THAN AIRFOIL LEADING (FORWARD) EDGE OF BLADES.

NOTE: When performing the following step, assemble components as indexed at disassembly. When an indexed rotating component has been replaced, assembly replacement component with high tooth markings (V or I) on mating curvic couplings located 180 degrees apart.

Prior to installing second and third stage nozzles in the following steps, center the abradable seals of the nozzles by hand or with rawhide mallet to clear mating knife-edge seals. Use care not to damage abradable material.

(c) Visually confirm aft nut locking key is securing position of the shaft. Install third stage turbine nozzle and aft seal ring (side with holes facing aft), then place second stage turbine rotor assembly in position on third stage turbine rotor assembly. Ensure side of second stage turbine rotor assembly stamped aft faces third stage turbine rotor assembly.

(d) Install center seal ring (side with holes facing aft).

NOTE: Later part numbered rotating seals are stamped with the word FORWARD. When performing the following step, ensure that rotating seal is installed with side stamped FORWARD oriented properly.

1. C. (1) (e) Install rotating seal.

(f) Install second stage turbine nozzle, ensuring slots are properly located in mating tangs of third stage turbine nozzle and that curvic couplings of rotating seal remain properly mated.

(g) Install first stage turbine rotor assembly on rotating seal.

(h) Install forward seal ring.

(i) Install new forward nut locking keys in slots of tie shaft.

(j) Install shaft and seal assembly on first stage turbine rotor assembly.

(k) Coat thread and face of nut and threads of tie shaft with high temperature compound (Fel-Pro C5-A) and install shaft nut on tie shaft until finger tight.

(l) Apply hand pressure to forward end of module (to collapse V-shaped seal rings installed between curvic couplings of module components), then tighten nut hand tight.

NOTE: Before proceeding, ensure shaft nut on tie shaft is threaded onto tie shaft far enough that shaft nut will not interfere with seating of cylindrical shaft of 293613-1 gage on end of tie shaft.

(m) Remove assembled module from bore of 289787-1 holder. Install shouldered plug of 293613-1 gage in bore of 289787-1 holder. Install assembled module on shouldered plug.

(n) Install cylindrical shaft, gage rod, and sleeve of 293613-1 gage into shaft end of module. Rotate gage to align slot in gage with cross of forward nut locking keys inside tie shaft and seat gage rod on ball in shouldered plug.

1. C. (1) (o) Measure and record dimension from surface of cylindrical shaft to top surface of gage rod. Record as Dimension E (figure 204), Zero Stretch Dimension, on data sheet (table 204).

(p) Measure and record dimension from surface of cylindrical shaft to top surface of curvic coupling teeth on shaft and seal assembly. Record as Dimension F (figure 204) on data sheet (table 204).

(q) Subtract Dimension E from Dimension F and record result (table 204). Compare result with Reference Unstretched Curvic Coupling Dimension recorded at disassembly (step 1.B.(13)) and record difference (table 204). If original rotating components were reinstalled, compared dimensions shall be the same within 0.004 inch. If any replacement rotating components were installed, compared dimensions shall be the same within 0.024 inch. If required, repeat step (1) using increased hand pressure to obtain required dimension.

1. C. (2) Stretch tie shaft to obtain dimensional stretch of 0.0076 to 0.0096 inch using 293003-1 or 293003-2 fixture as follows.

WARNING: DO NOT STAND ABOVE, BELOW, OR BEHIND SHAFT STRETCH FIXTURE WHEN PRESSURE IS APPLIED TO FIXTURE IN THE FOLLOWING STEPS. A FAILURE OF FIXTURE OR TIE SHAFT WOULD EXPEL FIXTURE FROM SHAFT WITH CONSIDERABLE FORCE.

CAUTION: WHEN PERFORMING THE FOLLOWING PROCEDURE, MAKE CERTAIN FORCE SPECIFIED IS NOT EXCEEDED TO ENSURE SHAFT IS NOT OVERSTRETCHED. IF SPECIFIED STRETCH IS EXCEEDED, APPLY PRESSURE WITH SHAFT STRETCH FIXTURE (NOT TO EXCEED SPECIFIED PRESSURE) SUFFICIENT TO LOOSEN SHAFT NUT, RELIEVE HYDRAULIC PRESSURE ON FIXTURE, AND REPEAT PROCEDURE. ENSURE 293003-1 or 293003-2 FIXTURE IS USED. USE OF SHAFT STRETCH FIXTURE OTHER THAN PART NO. 293003-1 or 293003-2 MAY OVERSTRETCH SHAFT OR NOT PROVIDE SUFFICIENT STRETCH AT PRESSURE SPECIFIED.

NOTE: When performing the following step, ensure large wing nut on shaft stretch fixture does not bottom on fixture until expanding collet is properly engaged in tie shaft.

R (a) Clean threads of 293003-1 or 293003-2 fixture components and mating threads for fixture on engine component. Lubricate threads on threaded rod of fixture with a light coat of lubricating compound (Liqui-Moly, Grade NV, thread compound). Install expanding collet of fixture into internal diameter of tie shaft. Turn small wing nut on fixture (to expand collet and engage internal shoulder of tie shaft) until collet is tight inside tie shaft, then turn counterclockwise until collet is free to move.

(b) Secure hydraulic cyclinder and adapter of fixture against taper of low pressure shaft and seal assembly with large wing nut on fixture. Install wing nut to bottoming position, then back wing nut out two turns.

1. C. (2) (c) Use hand pressure to align cylinder of fixture concentrically with expanding collet shaft, then apply sufficient pressure with hydraulic pump of fixture to support cylinder in aligned position.

(d) Slowly continue to increase pressure with hydraulic pump of fixture until fixture pressure gage indicates 2300 psig.

(e) Turn fixture wrench clockwise to tighten shaft nut hand tight.

(f) Slowly relieve hydraulic pressure on fixture and remove fixture.

(g) Install shouldered plug of 293613-1 gage in bore of 289787-1 holder. Install assembled module on shouldered plug.

(h) Install cylindrical shaft, gage rod, and sleeve of 293613-1 gage into shaft end of module. Rotate gage to align slot in gage with cross-key inside tie shaft and seat rod on ball of shouldered plug.

(i) Measure and record dimension from surface of cylindrical shaft to top of gage rod. Record as Dimension G (figure 204), Shaft Stretch Dimension, on data sheet (table 204).

CAUTION: WHEN REQUIRED TO INCREASE HYDRAULIC PRESSURE ON FIXTURE AS SPECIFIED IN THE FOLLOWING STEP, DO NOT EXCEED MAXIMUM HYDRAULIC PRESSURE SPECIFIED ON FIXTURE.

(j) Subtract Zero Stretch Dimension recorded in step (1)(o) from Shaft Stretch Dimension of previous step and record result (table 204). Difference (amount of shaft stretch) shall be 0.0076 to 0.0096 inch. Either tab on forward nut locking keys shall be aligned with castellation on nut. If shaft stretch is less than specified, repeat steps (a) through (j) as required with hydraulic pressure applied in step (d) increased 100 psig at each repetition until specified stretch is obtained. If either tab on forward nut locking keys cannot be aligned with castellation on shaft nut within specified stretch range, remove shaft nut (step 1.B.) and repeat steps (a) through (j) with new shaft nut installed.

1. C. (2) (k) Measure and record dimension from surface of cylindrical shaft to top surface of curvic coupling teeth on shaft and seal assembly. Record as Dimension H.

(l) Subtract Dimension G recorded in step (i) from Dimension H of previous step. Compare result with Reference Stretched Curvic Dimension recorded at disassembly (step 1.B.(5)). If original rotating components were reinstalled, compared dimensions shall be the same within 0.004 inch. If any replacement rotating components were installed, compared dimensions shall be the same within 0.024 inch. If tab on forward nut locking key cannot be aligned with castellation on shaft nut within specified stretch range, remove shaft nut and repeat steps (a) through (l) with new shaft nut.

(m) Bend tab on aligned forward nut locking key into nut castellation.

D. Install LP Turbine Module (See Figure 201)

(1) Remove 289783-1 or 291926-1 fixture.

NOTE: Ensure that tabs on third stage turbine nozzle are in slots on second stage turbine nozzle when installing module on engine.

Nozzle slots/tangs are not retained in position until module is properly seated on engine. Disengagement will not permit module bolt circle to seat on interstage turbine duct flange. Off-set in turbine module bolt is at the 12-o'clock position.

(2) Position turbine module on engine, ensuring indexing marks on turbine module shaft and tie rod are aligned. Five-inch lengths of 0.190-32 UNJF-3A bolt stock may be temporarily installed on transition duct bolt circle to support module at installation to aid assembly. If turbine module shaft has no indexing marks, install turbine module with high point marks (V or I) on mating curvic couplings 180 degrees apart. Verify engagement by turning turbine module rotating group back and forth and noting that fan rotor assembly rotates. With curvic couplings properly engaged, hand load turbine module forward until tie rod nut is installed.

1. D. (3) Apply lubricating compound (Liqui-Moly, Grade NV, thread compound) to threads of tie rod and to threads and face of tie rod nut. Install tie rod nut on tie rod hand tight. Wipe off any excess lubricating compound and ensure aft face of tie rod nut is clean.

(4) Install thrust and exhaust nozzle in accordance with steps 1.B.(5) and 1.B.(6) only of 72-50-02, MAINTENANCE PRACTICES.

(5) Install low pressure turbine roller bearing in accordance with steps 1.B. (1) through 1.B.(3) only of 72-50-01, MAINTENANCE PRACTICES.

NOTE: Hand load the turbine module forward (with approximately 15 pounds of force) during all dimensional measurements of the following steps.

(6) Measure and record Dimension H (on work sheet of Table 203) from Surface A on thrust and exhaust nozzle to Surface B on turbine module third stage shaft. (See figure 202.) Ensure measurement is taken from points marked during removal.

(7) Measure and record Dimension J (on work sheet of Table 203) from Surface A on thrust and exhaust nozzle to Surface C on tie rod. (See figure 202.) Ensure measurement is taken from points marked during removal.

NOTE: It is permissible that the dimensional requirement of the following step be within 0.030 inch of measurement recorded in steps 1.A.(10) and (11) if components other than those removed at disassembly are installed.

(8) Compare Dimension H (step (6)) with Dimension F (step 1.A.(10)) recorded at removal. Compare Dimension J (step (7)) with Dimension G (step 1.A. (11)) recorded at removal. Compared dimensions shall be the same within 0.015 inch. If dimensions are not as specified, curvic coupling teeth are not properly aligned. If required, remove thrust and exhaust nozzle and repeat steps (2) through (8) to obtain correct curvic coupling teeth alignment.

WARNING: DO NOT STAND BEHIND, ABOVE, OR BELOW SHAFT STRETCH FIXTURE WHEN PRESSURE IS APPLIED TO FIXTURE IN THE FOLLOWING STEPS. A FAILURE OF FIXTURE OR ENGINE TIE ROD WOULD EXPEL FIXTURE AFT WITH CONSIDERABLE FORCE.

CAUTION: WHEN PERFORMING THE FOLLOWING PROCEDURE, MAKE CERTAIN FORCE SPECIFIED IS NOT EXCEEDED TO ENSURE TIE ROD IS NOT OVERSTRETCHED. IF SPECIFIED STRETCH IS EXCEEDED, APPLY PRESSURE WITH SHAFT STRETCH FIXTURE (NOT TO EXCEED PRESSURE SPECIFIED FOR SHAFT STRETCH FIXTURE USED) SUFFICIENT TO LOOSEN TIE ROD NUT, RELIEVE HYDRAULIC PRESSURE ON FIXTURE, AND REPEAT PROCEDURE. ENSURE LOAD REACTS THROUGH ROTATING GROUP AND NOT AGAINST STATIC STRUCTURE. ENSURE PROPER SPECIAL TOOLING IS USED.

1. D. (9) (Post SB72-3119) Stretch tie rod as follows using
R 291960-1 or 291960-2 fixture to obtain dimensional
R stretch of 0.0695 to 0.0715 inch.

R (a) Disassemble 291960-1 or 291960-2 fixture to
R separate threaded rod and wrench. Clean threads
R of fixture components and mating threads for fix-
R ture on engine component. Lubricate threads on
R threaded rod of fixture with a light coat of lu-
R bricating compound (Liqui-Moly, Grade NV, thread
R compound). Install brass nut of fixture onto exposed threads of third stage shaft to protect threads during stretch of tie rod in the following steps. Install brass nut to depth that positions aft face of nut 0.010 to 0.030 inch forward of end of third stage shaft.

NOTE: Steps (b) through (e) are performed to ensure maximum thread engagement of fixture rod and tie rod before applying hydraulic pressure to fixture.

(b) Apply a small amount of lubricating compound (Liqui-Moly, Grade NV, thread compound) to face of fixture rod which will contact aft face of tie rod nut when rod is bottomed.

(c) Thread fixture rod onto exposed threads of tie rod until rod bottoms against aft face of tie rod nut. Make reference mark on end of fixture rod to aid counting turns, then back fixture rod out, counting turns required to remove rod. Note number of turns required.

D. (9) (d) Inspect aft face of tie rod nut to ensure presence of lubricating compound (Liqui-Moly, Grade NV, thread compound). Presence of lubricating compound (Liqui-Moly, Grade NV, thread compound) indicates full engagement of fixture rod with tie rod nut when rod is threaded onto tie rod with number of turns noted in previous step.

CAUTION: A MINIMUM NUMBER OF SEVEN THREADS SHALL BE ENGAGED WHEN PERFORMING THE FOLLOWING STEPS. IF LESS THAN SEVEN TURNS ARE COUNTED WHEN INSTALLING FIXTURE ROD, DO NOT CONTINUE PROCEDURE.

(e) Thread fixture rod onto exposed threads of tie rod to bottoming position, ensuring same number of threads are engaged as noted in step (c). Do not back rod out from this position.

(f) Slide wrench position of fixture forward over fixture rod to engage tie rod nut.

(g) Carefully assemble adapter and cylinder assembly of fixture over rod. Secure assembly with fixture bushing and wing nut on end of rod holding fixture forward against third stage shaft of turbine module. Install wing nut to bottoming position, then back wing nut out one-fourth turn.

(h) Use hand pressure to align cylinder assembly of fixture concentrically with fixture rod, then apply sufficient pressure with hydraulic pump of fixture to support cylinder in aligned position.

(i) Slowly continue to apply pressure with hydraulic pump of fixture until fixture pressure gage indicates 2700 to 3000 psig. Turn fixture wrench clockwise to seat tie rod nut hand tight. Support cylinder assembly of fixture with hand pressure and slowly relieve pressure on fixture. Thread rod of fixture onto tie rod until rod bottoms on tie rod nut. Engage fixture wrench on tie rod nut. Tighten fixture wing nut on rod of fixture, then back out one-fourth turn.

(j) Align cylinder assembly of fixture concentrically with fixture rod, then apply sufficient pressure with hydraulic pump of fixture to support cylinder in aligned position.

1. D. (9) (k) Slowly continue to apply pressure with hydraulic pump of fixture until fixture pressure gage indi-
R cates 4400 psig.

(l) Turn fixture wrench clockwise to tighten tie rod nut hand tight.

(m) Slowly relieve hydraulic pressure on fixture and remove fixture.

CAUTION: WHEN REQUIRED TO INCREASE HYDRAULIC PRESSURE ON FIXTURE AS SPECIFIED IN THE FOLLOWING STEP, DO NOT EXCEED MAXIMUM HYDRAULIC PRESSURE SPECIFIED ON FIXTURE.

NOTE: Take measurement at previously made markings.

(n) Measure tie rod stretch to ensure tie rod has been
R stretched 0.0695 to 0.0715 inch. If stretch is less than specified, proceed as follows.

1) Thread fixture rod onto tie rod to bottoming position.

2) Carefully assemble adapter and cylinder assembly of fixture over rod, using care not to damage exposed threads of third stage rotor shaft on low pressure turbine module. Secure assembly with wing nut on end of rod, holding fixture forward against third stage shaft of turbine module. Install wing nut to bottoming position, then back wing nut out one-fourth turn.

3) Repeat steps (e) through (h), (k), (l), and (m) with hydraulic pressure applied in step (k) increased 50 psig at each repetition of procedure until specified stretch is obtained. Do not exceed maximum hydraulic pressure specified on fixture.

NOTE: Hand load the turbine module forward (with approximately 15 pounds of force) during all dimensional measurements.

(10) Measure and record Dimension K (on work sheet of Table 203) from Surface A on thrust and exhaust nozzle to Surface B on turbine module third stage shaft. (See figure 202.) Ensure measurement is taken from points marked during removal.

1. D. (11) Measure and record Dimension L (on work sheet of Table 203) from Surface A on thrust and exhaust nozzle to Surface C on tie rod. (See figure 202.) Ensure measurement is taken from points marked during removal.

(12) Install N1 transducer installation (except for transducer access cover plate) in accordance with 77-10-03, MAINTENANCE PRACTICES.

(13) Install hardware securing thermocouple harness and N1 transducer leads with clamps, bolts and nuts in accordance with 72-50-03, MAINTENANCE PRACTICES.

(14) Install rear turbine bearing oil tubes in accordance with 79-20-05, MAINTENANCE PRACTICES.

(15) Install N1 transducer access cover plate in accordance with 77-10-03, MAINTENANCE PRACTICES.

(16) Install oil tube assemblies which connect at bosses on right side and bottom of thrust and exhaust nozzle in accordance with 79-20-04, MAINTENANCE PRACTICES.

(17) Perform vibration check in accordance with 72-00-00, GENERAL - ADJUSTMENT/TEST, paragraph 12.

2. Inspection/Check

Table 205. Special Tools, Fixtures and Equipment

Item No.	Nomenclature	Use	Source Part No.
NOTE: Equivalent substitutes may be used for listed item.			
1.	LP Turbine Rotor Gage Set	Allows dimensional measurement of discs of LP rotor assemblies.	294130-1

2. A. Inspect Low Pressure Turbine Module

CAUTION: USE CARE WHEN HANDLING COMPONENTS WITH CURVIC COUPLINGS AND KNIVE EDGE SEALS TO AVOID DAMAGE. REFER TO 70-00-00, 6, COMPONENTS HANDLING.

(1) When low pressure turbine module is not to be disassembled, inspect assembly as follows.

(a) Visually inspect portions of turbine rotor assemblies which are visible for cracks, heat erosion, and distortion. If cracks, heat erosion, or distortion is evident, disassemble module and inspect module components in accordance with step (2).

(b) Visually inspect nozzles for cracks and distortion. If cracks or distortion is evident, disassemble module and inspect module components in accordance with step (2).

(2) When low pressure turbine module is disassembled, inspect components as follows.

(a) Perform fluorescent penetrant inspection (in accordance with MIL-I-6866, Type I, Method B, or
R better) on rotating seal. Replace part if any indications or cracks are noted.

R (a1) Visually inspect all curvic coupling teeth for
R handling/misassembly damage. Refer to 70-00-00,
R 6, Component Handling.

(b) Inspect abradable seal diameter mating with knife-edge seals for damage to contact path, both axially and on circumference. Slight chips and nicks in the seal edges are acceptable. Cracks that do not extend beyond the first knife-edge seal groove are acceptable. Flaking and chipping that do not extend beyond all knife-edge seal grooves are acceptable. Eccentric grooved patterns in abradable material seal area are acceptable but groove depth shall not exceed 0.030 inch. Refer to 70-00-00, GENERAL - STANDARD PRACTICES for general requirements. Replace second or third stage abradable seal, or seal portion of shaft and seal assembly in accordance with 4, Approved Repairs when inspection criteria is not met.

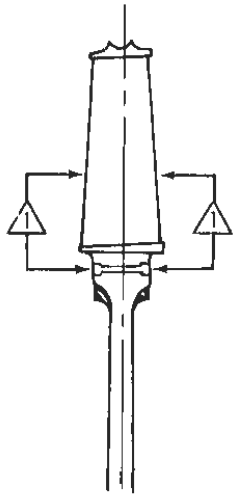
2. A. (2) (c) Determine clearance for knife edge seal blades on rotating seal as follows.

1) Measure and record outside diameter of knife edge seal blades on rotating seal.

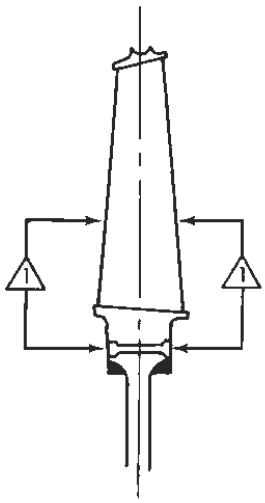
2) Measure and record inside diameter of abradable seal on second stage turbine nozzle which mates with knife edge seal blades on rotating seal. Measure abradable material at unworn area approximately 0.10 inch aft of leading edge of abradable material.

3) Subtract dimension recorded in step 1) from dimension recorded in step 2). Difference (knife edge seal blade clearance) shall be 0.020 inch maximum. If clearance is not as specified, replace part or parts as required to obtain specified clearance. Manufactured (blue print) dimensions are as follows: knife-edge seal blades diameter, 7.488 to 7.491 inch; abradable seal on second stage turbine nozzle, 7.497 to 7.500 inch.

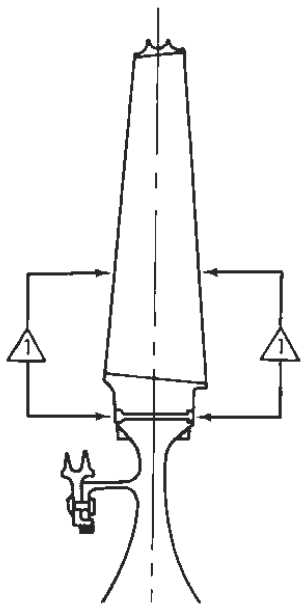
R Figure 205 Deleted



FIRST STAGE ROTOR ASSY



SECOND STAGE ROTOR ASSY



THIRD STAGE ROTOR ASSY

NOTE: SYMBOL ⚠1 IDENTIFIES AREAS FOR PARTICULAR ATTENTION AT INSPECTION (FIR TREE AREAS THROUGH APPROXIMATELY FIRST ONE-THIRD SPAN OF BLADE LEADING AND TRAILING EDGES.

I-48A-367

Turbine Rotor Assembly Inspection
Figure 206

2. A. (2) (d) Determine clearance for knife edge seal blades on forward side of third stage rotor assembly as follows.

1) Measure and record outside diameter of knife edge seal blades on forward side of third stage rotor assembly.

2) Measure and record inside diameter of abradable seal on third stage turbine nozzle which mates with knife edge seal blades of third stage rotor assembly.

3) Subtract dimension recorded in step 1) from dimension recorded in step 2). Difference (knife edge seal blade clearance) shall be 0.020 inch maximum. If clearance is not as specified, replace part or parts as required to obtain required clearance. Manufactured (blue print) dimensions are as follows: knife edge seal blade diameter, 7.488 to 7.491 inch; abradable seal on third stage turbine nozzle, 7.497 to 7.500 inch.

CAUTION: ENGINE LOG BOOK (LIFE LIMITED PART LOG) SPECIFIES AMOUNT OF MATERIAL REMOVED FROM BLADES OF EACH ROTOR ASSEMBLY SINCE ROTOR ASSEMBLY WAS LAST BALANCED. ADD VALUES LISTED FOR THREE ROTOR ASSEMBLIES. IF TOTAL IS GREATER THAN 0.0375 SQUARE INCH, BALANCING IS REQUIRED FOR ONE OR MORE ROTOR ASSEMBLIES TO ENSURE ROTATING GROUP IS SUFFICIENTLY BALANCED. REFER TO 2, APPROVED REPAIRS.

NOTE: When inspection of blades indicates that repair will require more than 0.0375 square inch of airfoil material to be removed from blade set on a rotor assembly (as calculated in 4, Approved Repairs, figure 213), return rotor assembly to an AiResearch Approved Repair Center for repair.

(e) Inspect first, second, and third stage turbine rotor assemblies. Pay particular attention to fir tree areas and to inner one-third span area of blades. (See figure 206.) Use 20X magnification for inspection of fir tree areas of discs and blades. No magnification is required for inspection of rivets. Either 20X magnification or fluorescent penetrant inspection (in accordance

with MIL-I-6866) may be used for airfoil areas of blades. Inspect both forward and aft sides of rotor assemblies for the following.

2. A. (2) (e) 1) Cracks. No cracks are allowed on discs, blades, or rivets. Replace cracked blades or rivets in accordance with 4, Appproved Repairs.

2) Airfoil nicks on leading or trailing edges of blades. Repair or replace blades with nick damage in accordance with 4, Approved Repairs. (See figure 207).

3) Airfoil dents on leading or trailing edge. (Dent inspection may be accomplished visually without magnification, using a strong light.) Repair or replace blades with dent damage in accordance with 4, Approved Repairs. (See figure 207.)

4) Damaged knife edge seal blades on outer shroud of blades. Minor damage (caused by blade rub on shroud) or nicks (no greater than 0.010 inch in depth and 0.040 in length) on knife edge seal blades are acceptable.

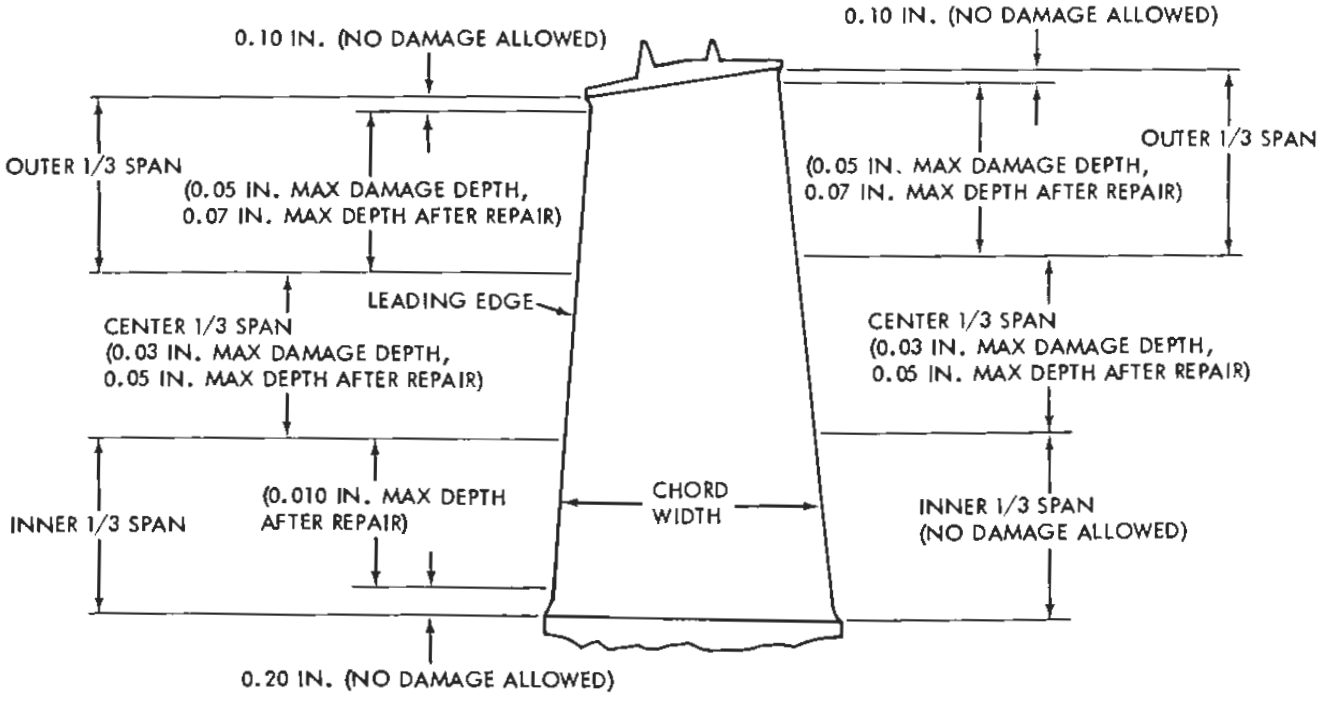
(f) Dimensionally inspect first, second, and third stage turbine rotor assemblies as follows using 294130-1 gage set. (See figure 208.)

CAUTION: 294130-1 GAGE SET IS PRECISION EQUIPMENT AND CAN BE DAMAGED EASILY. USE EXTREME CARE WHEN HANDLING GAGE SET TO PREVENT DAMAGE. USE EXTREME CARE WHEN PLACING GAGE ON CURVIC COUPLING OF ROTOR ASSEMBLIES TO PREVENT DAMAGE OF CURVIC COUPLINGS.

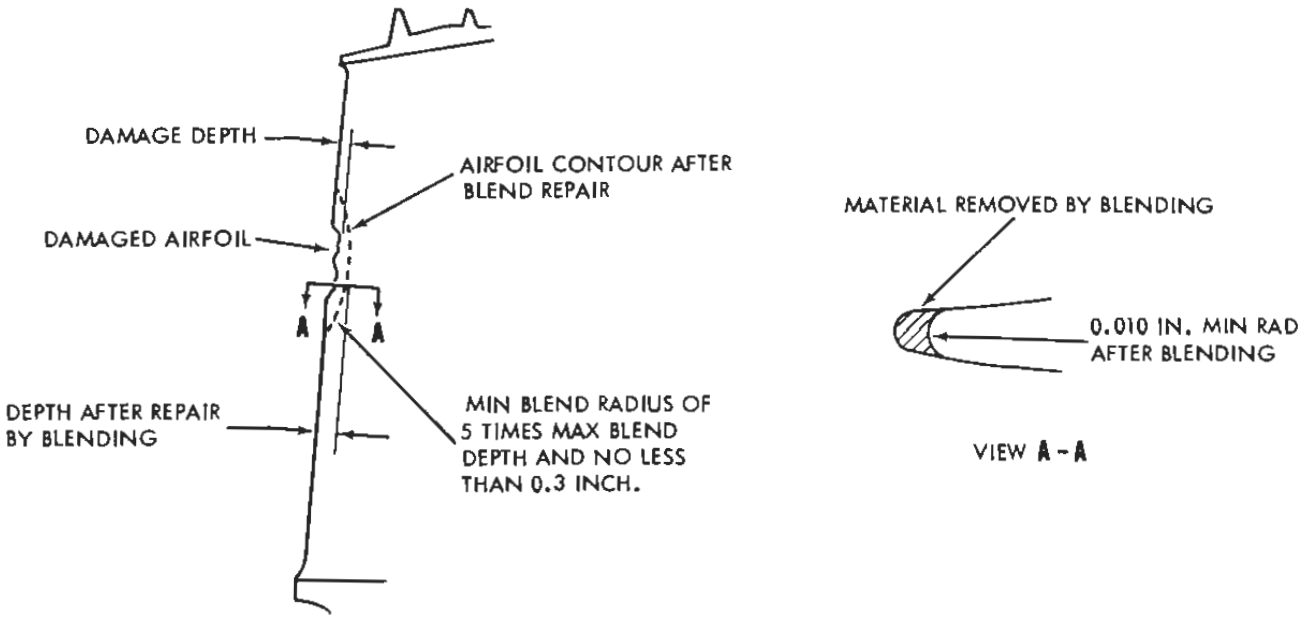
1) Install gage portion of gage set on forward side of first stage turbine rotor assembly. Rest gage portion across curvic coupling. Adjust position of measuring tips on gage portion to set upper flat surface of each measuring tip flush with adjacent disc surface. (See figure 208.)

2) With position of measuring tips established, install gage portion on 8.520-inch diameter calibration ring of gage set. Position dial indicator on gage portion for zero indication at calibration ring diameter.

NOTE:
REPAIR IS NOT ALLOWED ON BOTH LEADING AND TRAILING EDGES AT SAME RADIUS.
NO STRAIGHTENING OF DAMAGED MATERIAL IS ALLOWED



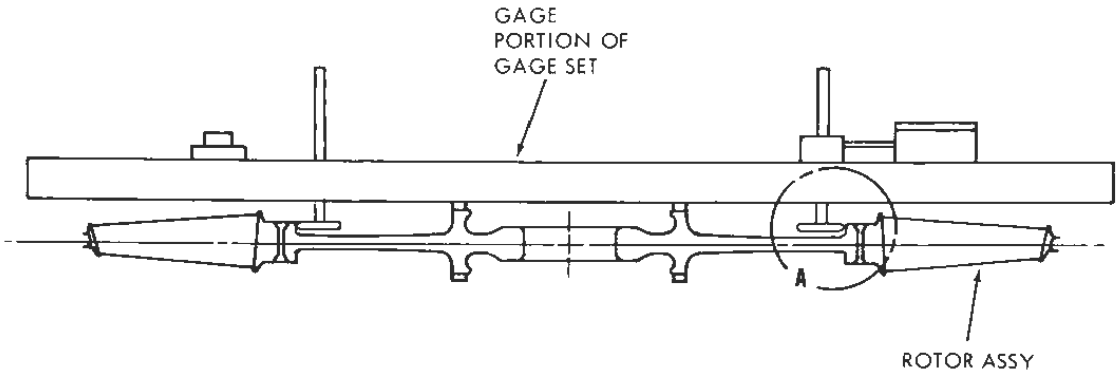
DAMAGE AND REPAIR LIMITS

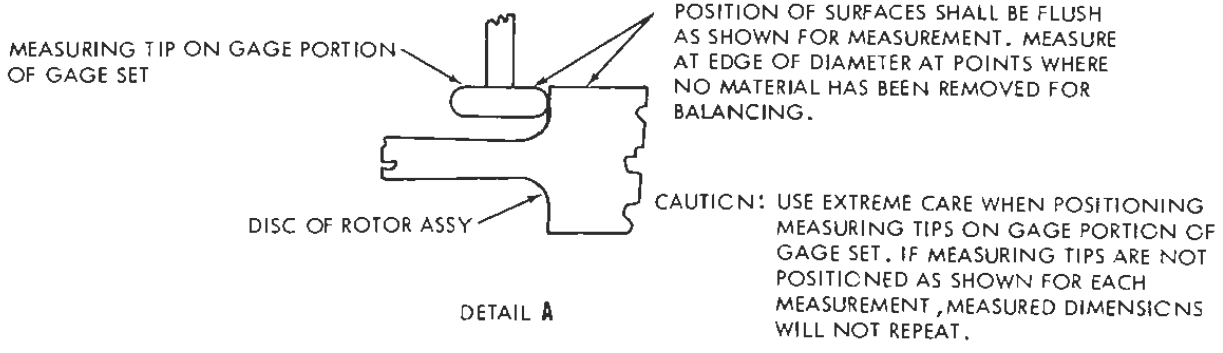


TYPICAL REPAIR EXAMPLE

I-48A-362

Turbine Rotor Assembly Blade Airfoil Inspection
Figure 207




MEASURING TIP ON GAGE PORTION
OF GAGE SET
POSITION OF SURFACES SHALL BE FLUSH
AS SHOWN FOR MEASUREMENT. MEASURE
AT EDGE OF DIAMETER AT POINTS WHERE
NO MATERIAL HAS BEEN REMOVED FOR
BALANCING.
DISC OF ROTOR ASSY
CAUTION: USE EXTREME CARE WHEN POSITIONING
MEASURING TIPS ON GAGE PORTION OF
GAGE SET. IF MEASURING TIPS ARE NOT
POSITIONED AS SHOWN FOR EACH
MEASUREMENT, MEASURED DIMENSIONS
WILL NOT REPEAT.
DETAIL A

1-48A-417

Rotor Assembly Dimensional Inspection using
Gage Set Part No. 294130-1
Figure 208

2. A. (2) (f) 3) Reinstall gage portion on forward face of rotor assembly, with gage resting on curvic coupling and upper surface of measuring tips flush with adjacent surface of disc. (See figure 208.) Ensure measuring tips do not contact areas where material has been removed for balancing.

4) Record dial indicator reading. Reading is difference measurement of calibration ring diameter and Diameter A (figure 209). If reading is less than zero, subtract reading from calibration ring diameter. If reading is greater than zero, add reading to calibration ring diameter. Result is measured Diameter A.

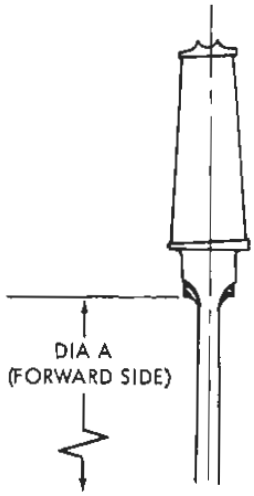
5) Compare measured Diameter A (step 4)) with reference baseline dimension (etched on web area of disc or entered on life limited part log of engine log book). Measured Diameter A and reference baseline dimension shall be the same within 0.010 inch. When no reference baseline dimension is available and the first major periodic inspection has been previously accomplished, measured Diameter A shall be as specified on Figure 209.

6) When performing this inspection at or prior to first scheduled major periodic inspection in accordance with 72-00-00, GENERAL - INSPECTION/ CHECK, paragraph 5, and baseline dimension is not etched on disc, enter measured Diameter A on life limited part log of engine log book to establish reference baseline dimension for subsequent inspections.

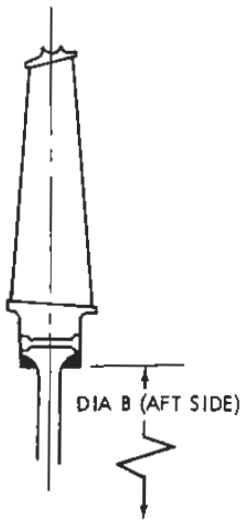
7) Repeat steps 1) through 6) for second stage turbine rotor assembly (Diameter B of figure 209), using 8.280 inch diameter calibration ring and using aft side of rotor assembly for measurements.

8) Repeat steps (1 through 6) for third stage turbine rotor assembly (Diameter C of figure 209), using 7.770 inch diameter calibration ring and using aft side of rotor assembly for measurements.

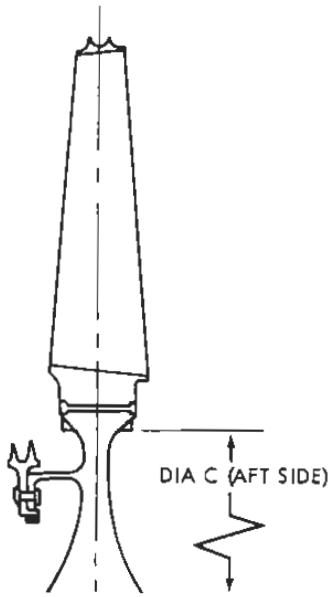
9) Return rotor assembly failing requirements of step 5), 7), or 8) to a Garrett approved repair center for inspection of assembly.



FIRST STAGE ROTOR ASSY



SECOND STAGE ROTOR ASSY



THIRD STAGE ROTOR ASSY

*MANUFACTURING DIMENSIONS

*A	*B	*C
8.510 TO 8.530 IN.	8.270 TO 8.290 IN.	7.760 TO 7.780 IN.

*MANUFACTURING DIMENSIONS ARE APPLICABLE ONLY WHEN NO ETCHED DIMENSION APPEARS ON COMPONENT AND NO DIMENSION IS ENTERED IN ENGINE LOG BOOK. REFER TO INSPECTION PROCEDURES FOR DIMENSIONAL TOLERANCES FROM ETCHED DIMENSION OR LOG BOOK DIMENSION.

MEASURE ROTOR ASSEMBLY DIMENSIONS ACROSS AREAS WHERE NO MATERIAL HAS BEEN REMOVED FOR BALANCING. MAKE MEASUREMENT ON INDICATED SIDE (FORWARD OR AFT) OF ROTOR ASSEMBLY.

1-48A-360

Rotor Assembly Dimensional Inspection
Figure 209

2. A. (2) (g) Inspect second and third stage nozzles. (See figure 210.)

1) Visually inspect nozzle assembly for warpage, distortion, and other damage.

2) Visually inspect vane convex and concave surfaces for nicks or dents.

3) Visually inspect vane leading and trailing edges for nicks.

4) Inspect rivets for cracks and security.

5) Inspect nozzle vanes for cracks. Criteria for cracks is as follows.

a) Cracks are not permissible in any portion of the nozzle except the vanes.

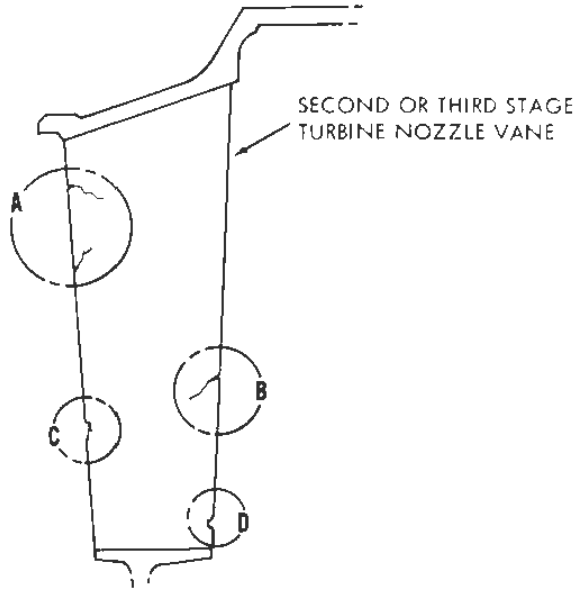
b) Cracks in vanes shall not exceed 0.250 inch in length.

c) A maximum of two cracks in a single vane is acceptable but cracks shall not intersect or be in an intersecting plane.

6) On third stage nozzle, inspect for cracked or broken tangs (for interlocking with second stage nozzle). Replace nozzle if three or more tangs are missing, or if two adjacent tangs are missing. Refer to 4, Approved Repairs if one tang is missing or if two non-adjacent tangs are missing.

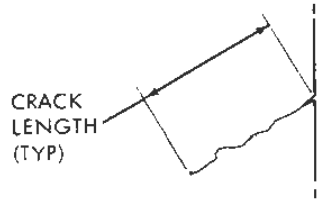
R 7) Inspect shroud area (for rotor assembly blades) on nozzles for grooving of shrouds
R (caused by blade rub). Grooving is acceptable
R if depth of grooving is not greater than 0.040 inch.

8) Refer to 4, Approved Repairs if inspection requirements are not met.

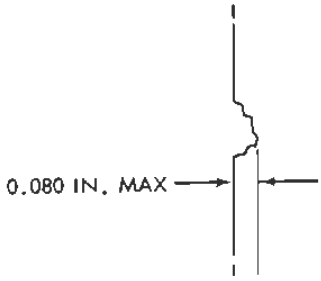


EXAMPLE OF CRACKS ON INTERSECTING PLANE (NOT ACCEPTABLE)

DETAIL **A**

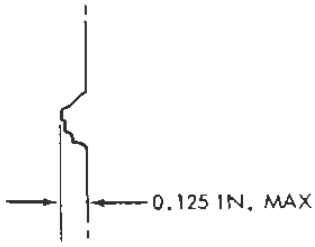


DETAIL **B**



EXAMPLE OF REPARABLE LEADING EDGE NICK

DETAIL **C**



EXAMPLE OF REPARABLE TRAILING EDGE NICK

DETAIL **D**

MORE THAN TWO CRACKS, OR CRACKS ON INTERSECTING PLANE, ARE NOT ACCEPTABLE.

CRACK LENGTH SHALL NOT BE GREATER THAN 0.250 INCH AND CRACK WIDTH SHALL NOT EXCEED 0.010 INCH.

I-48A-446

Nozzle Vane Inspection
Figure 210

3. Cleaning/Painting

A. Clean Parts

(1) Clean tie rod nut and turbine module in accordance with 72-00-00. GENERAL - CLEANING/PAINTING, Cleaning Method No. 1, 2, or 10.

4. Approved Repairs

Table 206. Special Tools, Fixtures and Equipment

Item No.	Nomenclature	Use	Source Part No.
NOTE: Equivalent substitutes may be used for listed items.			
* 1.	Turbine Wheel Riveting Fixture	Supports second stage turbine rotor assembly for riveting operation.	289921-1
* 2.	Turbine Wheel Riveting Fixture	Support first stage turbine rotor assembly for riveting operation.	289924-1
* 3.	Turbine Wheel Riveting Fixture	Supports third stage turbine rotor assembly for riveting operation.	289926-1
* 4.	Coupling	Supports shaft and seal assembly during balancing.	290562-1
* 5.	Nut	Retains turbine rotating assemblies during balancing.	290565-1
* 6.	Tie Bolt	Retains first stage turbine rotor assembly during balancing.	290566-6
* 7.	Tie Bolt	Retains second stage turbine rotor assembly during balancing.	290566-7
* 8.	Tie Bolt	Retains third stage turbine rotor assembly during balancing.	290566-8

*For use only at a Garrett Approved Repair Center.

Table 206. Special Tools, Fixtures and Equipment (Cont)

Item No.	Nomenclature	Use	Source/ Part No.
* 9.	Tie Bolt	Retains shaft and seal assembly during balancing.	290566-9
*10.	Coupling	Retains turbine rotating turbine assemblies during balancing.	290701-1
*11.	Coupling	Supports turbine rotating assemblies during balancing.	290702-1
*12.	Adapter	Supports third stage turbine rotor assembly during balancing.	290704-1 or 290704-2
*13.	Anvil	Adapts riveting machine during riveting operation.	291055-1
*14.	Flaring Tool	Flares rivets during riveting operation.	291892-1
*15.	Squeeze Type Riveting Machine	Rivets turbine rotor assemblies.	294119-1
*16.	Blade Loading Holder and Gage	Applies and measures load for checking rivet installation.	294125-2
*17.	Rotor Deriveting Set	Used for rivet removal from turbine rotor assemblies.	294127-1

*For use only at a Garrett Approved Repair Center.

Table 207. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
R Anhydrous lanolin	Commercially available
Penetrating oil (WD-40)	WD-40 Co, 1061 Cudahy Pl, San Diego, CA 92110

4. A. Repair Second and Third Stage Turbine Nozzles

(1) Blend leading and trailing edge nicks on nozzle vanes to remove damaged material when repair can be accomplished within the following limits. (See figure 210.)

NOTE: Do not repair cracks by blending. When crack propagates from leading edge nick or dent, blend only to repair nick or dent damage.

(a) Damage leading or trailing edge requires no more than one blend.

(b) No more than 13 vanes (second stage turbine nozzle) or 15 vanes (third stage turbine nozzle) require blending.

(c) Depth of blend required does not exceed 0.080 inch on leading edges.

(d) Depth of blend required does not exceed 0.125 inch on more than six trailing edges (second stage turbine nozzle) or seven trailing edges (third stage turbine nozzle), and depth of blend required does not exceed 0.080 inch on remainder of trailing edges to be blended.

(e) Blend lengths are at least five times blend depth.

(f) All areas where material is removed by blending fair smoothly with surface finish of AA125 or better.

(2) Blend nicks of dents on convex or concave surfaces of vanes to remove damaged material when repair can be accomplished within the following limits.

NOTE: Nicks or dents which can be inscribed by a 0.125 inch diameter and have a depth of less than 0.020 inch may be disregarded.

4. A. (2) (a) Blending does not reduce vane thickness more than one-half of local stock thickness on any vane, and not more than six vanes per nozzle are blended to full depth allowed.

(b) Blending is required for no more than six nicks or dents per vane side, with a separation of at least 0.125 inch between nicks or dents to be blended.

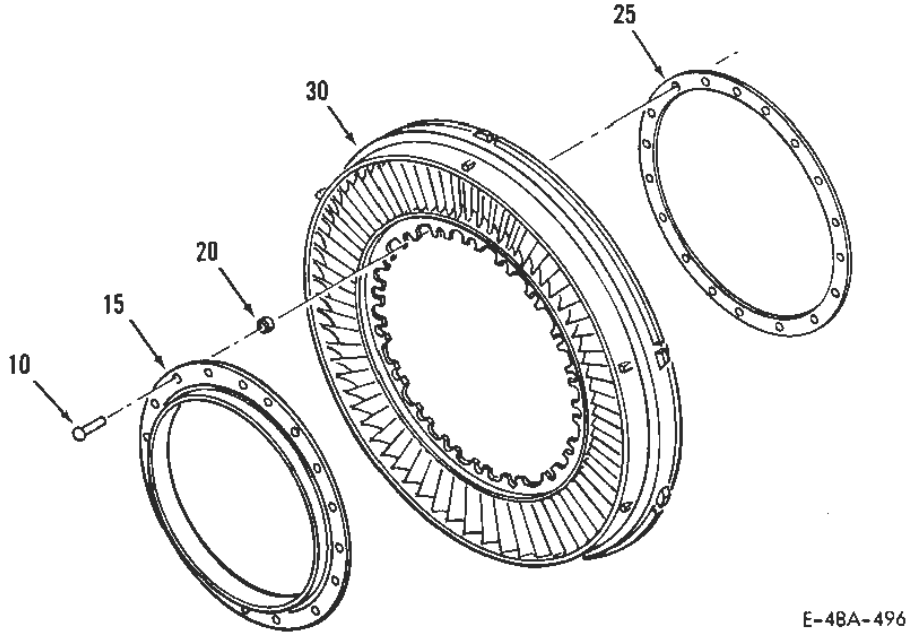
(c) Blend lengths are at least five times blend depth.

4. A. (2) (d) All areas where material is removed by blending fair smoothly with surface finish of AA125 or better with fillet and corner radii of 0.02 to 0.08 inch.

(3) When metal buildup is apparent on shroud areas (for rotor assembly blades) of nozzles, remove metal buildup by blending.

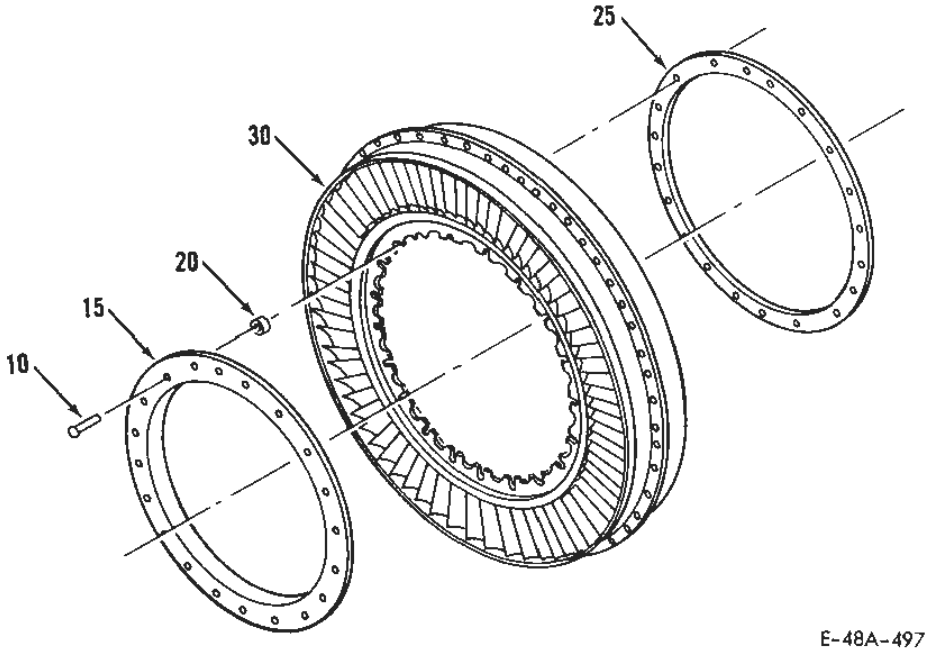
(4) On third stage turbine nozzle, remove cracked or broken tang (for interlocking with second stage turbine nozzle) at forward side of nozzle and handfinish to blend smooth with machined surface. No more than two missing tangs are allowable and missing tangs shall not be adjacent.

(5) Perform fluorescent penetrant inspection in accordance with MIL-I-6866, after repair on repaired areas. Cracks are not acceptable.



10. RIVET (IPC FIG. 103)
15. SEAL
20. SPACER
25. RING
35. NOZZLE

LP Second Stage Turbine Nozzle
Figure 211



10. RIVET (IPC FIG. 105)
15. SEAL
20. SPACER
25. RING
30. NOZZLE

LP Third Stage Turbine Nozzle
Figure 212

4. A. (6) Replace seal which does not meet inspection requirements. (See figure 211 or 212.)

(a) Drill out rivets and remove seal.

(b) Assemble new seal, spacers, ring, and nozzle. Secure components with rivets in accordance with 70-00-00, STANDARD PRACTICES.

(c) Radial movement of seal inside nozzle may be expected up to 0.060 inch.

(7) Replace part that is damaged beyond repair specified.

B. Repair First, Second, and Third Stage Rotor Assemblies

CAUTION: BLADE REPAIR REQUIRES MATERIAL REMOVAL. TOTAL ACCUMULATIVE AMOUNT OF MATERIAL REMOVED FOR COMPLETE BLADE SET OF EACH ROTOR ASSEMBLY SINCE LAST BALANCING OF ROTOR ASSEMBLY SHALL BE RECORDED ON LIFE LIMITED PART LOG OF ENGINE LOG BOOK.

USE CARE WHEN HANDLING COMPONENTS WITH CURVIC COUPLINGS AND KNIFE EDGE SEALS TO AVOID DAMAGE. REFER TO 70-00-00, 6, COMPONENT HANDLING.

(1) Repair blades by blending when airfoil nicks or dents may be repaired within limits of Figure 207. Blades damaged beyond limits specified shall be replaced in accordance with steps (2) through (7). Calculate and record, on life limit part log of engine log book, the square inch total of airfoil surface removed from complete blade set of rotor assembly. See Figure 213 for calculation method. Blade repair which results in removal of more than 0.0375 square inch airfoil surface for total blade set shall be accomplished at a Garrett Approved Repair Center.

CAUTION: THE FOLLOWING PARAGRAPHS SHALL BE PERFORMED ONLY BY A GARRETT APPROVED REPAIR CENTER. SERVICE CENTER REPAIR IS NOT AUTHORIZED.

4. B. (2) When blade repair requires removal of more than 0.0375 square inch of airfoil material from blade set, blend blades in accordance with step (1) and note total chord reductions for rotor assembly blade set at inner, center, and outer one-third spans of blades. Total chord reduction for rotor assembly blade set at leading edge of inner one-third span shall not exceed 0.10 inch. Total chord reduction at center one-third span shall not exceed 0.50 inch. Total chord reduction at outer one-third span shall not exceed 0.70 inch. After repair, balance rotor assembly in accordance with steps (6), (7), or (8), as applicable.

(3) Remove cracked or damaged rivets securing blades or rivets which must be removed to allow blade replacement as follows.

(a) Apply penetrating oil (WD-40) liberally to both heads of rivets to be removed. Allow penetrating oil to soak overnight.

(b) Install rotor assembly in holder portion of 294125-1 holder and gage.

CAUTION: WHEN PERFORMING THE FOLLOWING STEP, ENSURE FLARED PORTION OF RIVET IS COMPLETELY REMOVED TO AVOID DAMAGE TO DISC OR BLADE OF ROTOR ASSEMBLY.

(c) Remove flared portion of rivet using punch of 294127-1 deriveting kit.

(d) Using short drift of 294127-1 deriveting kit, drive rivet aft until rubber bumper on drift is seated against disc or rotor assembly.

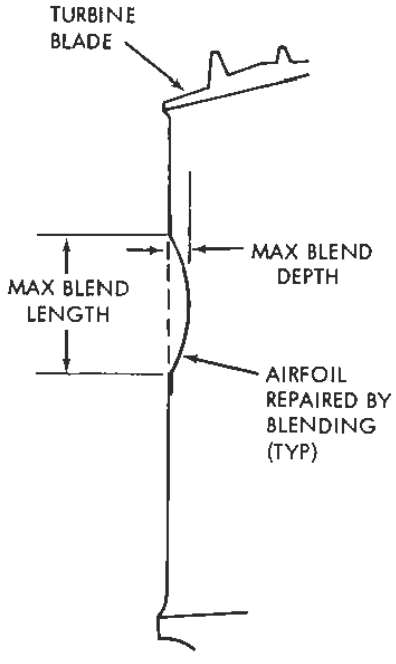
(e) Repeat step (d) using second longest drift of 294127-1 deriveting kit.

(f) Repeat step (d) using longest drift of 294127-1 deriveting kit to completely remove rivet from rotor assembly.

4. B. (4) Replace blades damaged beyond repair as follows.

(a) Apply penetrating oil (WD-40) liberally to fir tree areas of blade to be removed and to both heads of rivets securing blades to be removed. Allow penetrating oil to soak overnight.

(b) Remove rivet securing damaged blade in accordance with step (3). If blade is not loose following rivet removal, tap blade at platform area inward toward center of disc using aluminum drift of 294127-1 deriveting kit to loosen blade.



NOTES: FOR EACH BLEND REPAIR ON AIRFOIL, CALCULATE AREA OF REMOVED MATERIAL BY MULTIPLYING MAXIMUM BLEND DEPTH BY MAXIMUM BLEND LENGTH.

TOTAL AREA OF REMOVED MATERIAL ON COMPLETE BLADE SET OF ROTOR ASSEMBLY (SINCE LAST BALANCING) SHALL BE RECORDED ON APPLICABLE LIFE LIMITED PART LOG OF ENGINE LOG BOOK.

1-48A-363

Calculating Material Removed from Rotor Assembly Blade
Figure 213

NOTE: Z-contour of outer blade shrouds requires loosening blades adjacent to blade being replaced. Number of adjacent blades to be loosened will vary from assembly to assembly. Remove no more rivets securing adjacent blades and adjacent blades than required to allow removal of blade being replaced.

4. B. (4) (c) Remove rivets and loosen blades immediately adjacent to blade to be replaced, then manually work defective blade forward for removal. If required, remove rivets and loosen additional adjacent blades until defective blade may be removed.

(d) Install replacement blade and manually work replacement and adjacent blades back into fir tree sections of disc.

(e) Manually press outer shroud of each blade against outer shroud of each adjacent blade to check Z-gap dimension (Dimension J, figures 214, 215, or 216). If dimension is not as specified, blades shall be replaced as required to obtain specified dimension.

(f) On applicable life limited part log of engine log book, enter quantity and part number of new blades installed.

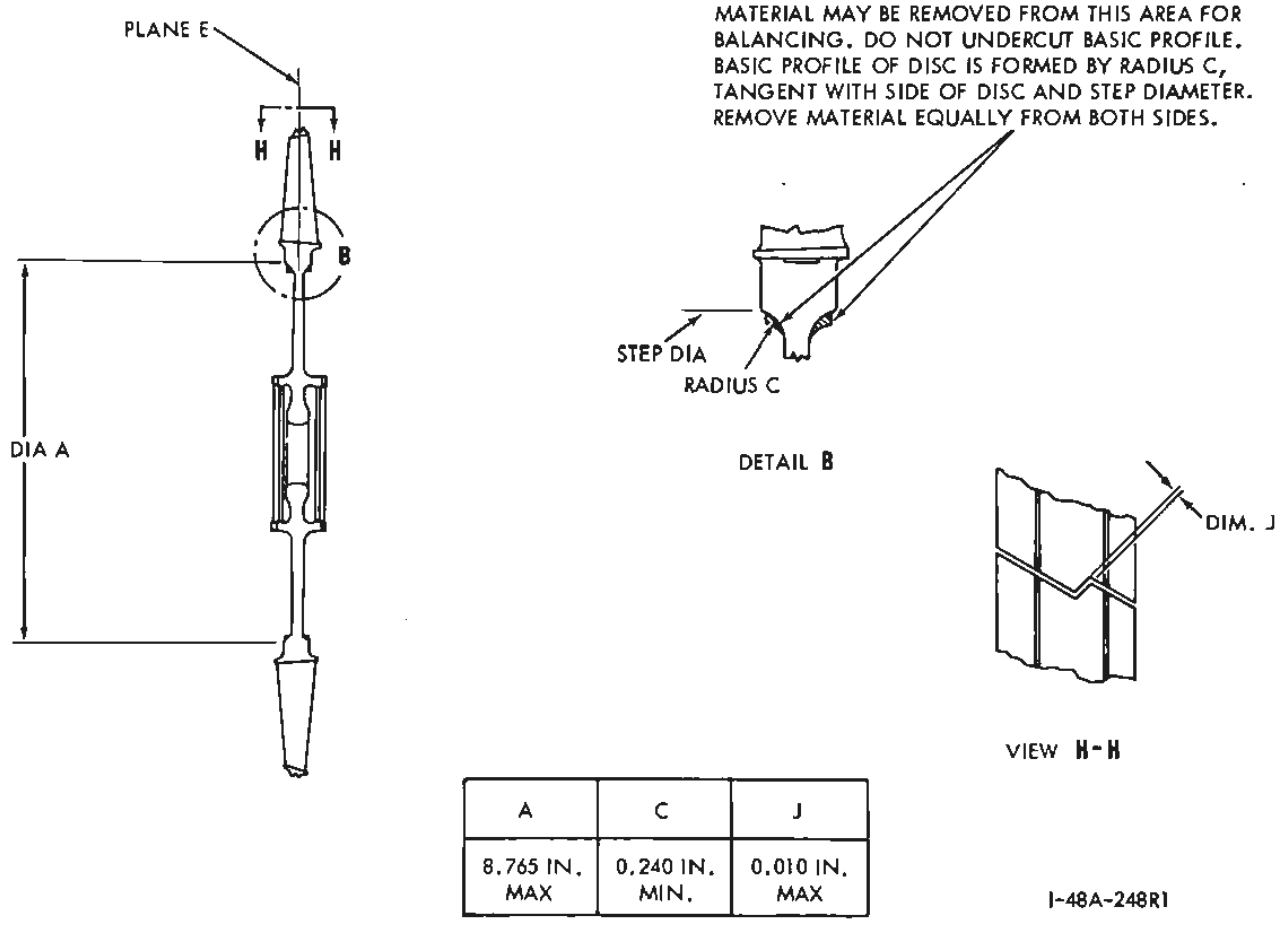
(5) Install replacement rivets.

(a) Select rivet for each location where rivets have been removed or are missing. At each location, use part number of applicable rivet which provides tightest fit and which can be lightly tapped into place or pressed into place with hand pressure.

(b) Install rotor assembly on applicable riveting fixture. First stage turbine rotor assembly requires 289921-1 riveting fixture; second stage turbine rotor assembly requires 289924-1 riveting fixture; and third stage turbine rotor assembly requires 289926-1 riveting fixture.

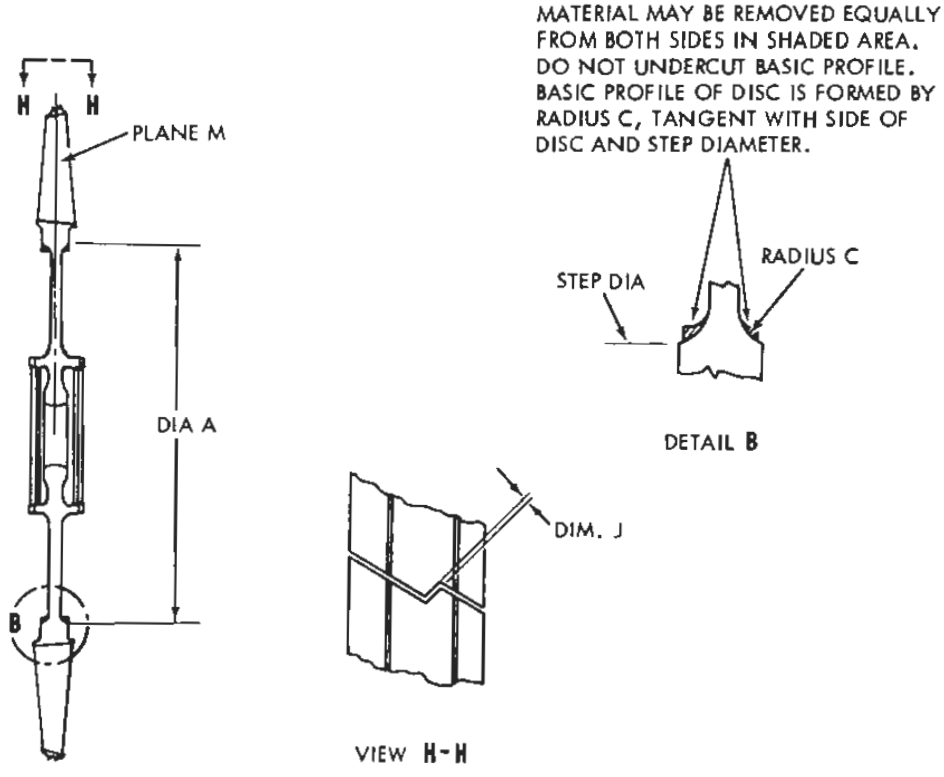
(c) Coat 291892-1 flaring tool, or hollow shank of new rivets, with anhydrous lanolin.

(d) Flare rivets using 291055-1 anvil, 291892-1 flaring tool, and 294119-1 riveting machine.


PLANE E
H
H
B
DIA A
MATERIAL MAY BE REMOVED FROM THIS AREA FOR BALANCING. DO NOT UNDERCUT BASIC PROFILE. BASIC PROFILE OF DISC IS FORMED BY RADIUS C, TANGENT WITH SIDE OF DISC AND STEP DIAMETER. REMOVE MATERIAL EQUALLY FROM BOTH SIDES.
STEP DIA
RADIUS C
DETAIL B
DIM. J
VIEW H-H

A	C	J
8.765 IN. MAX	0.240 IN. MIN.	0.010 IN. MAX

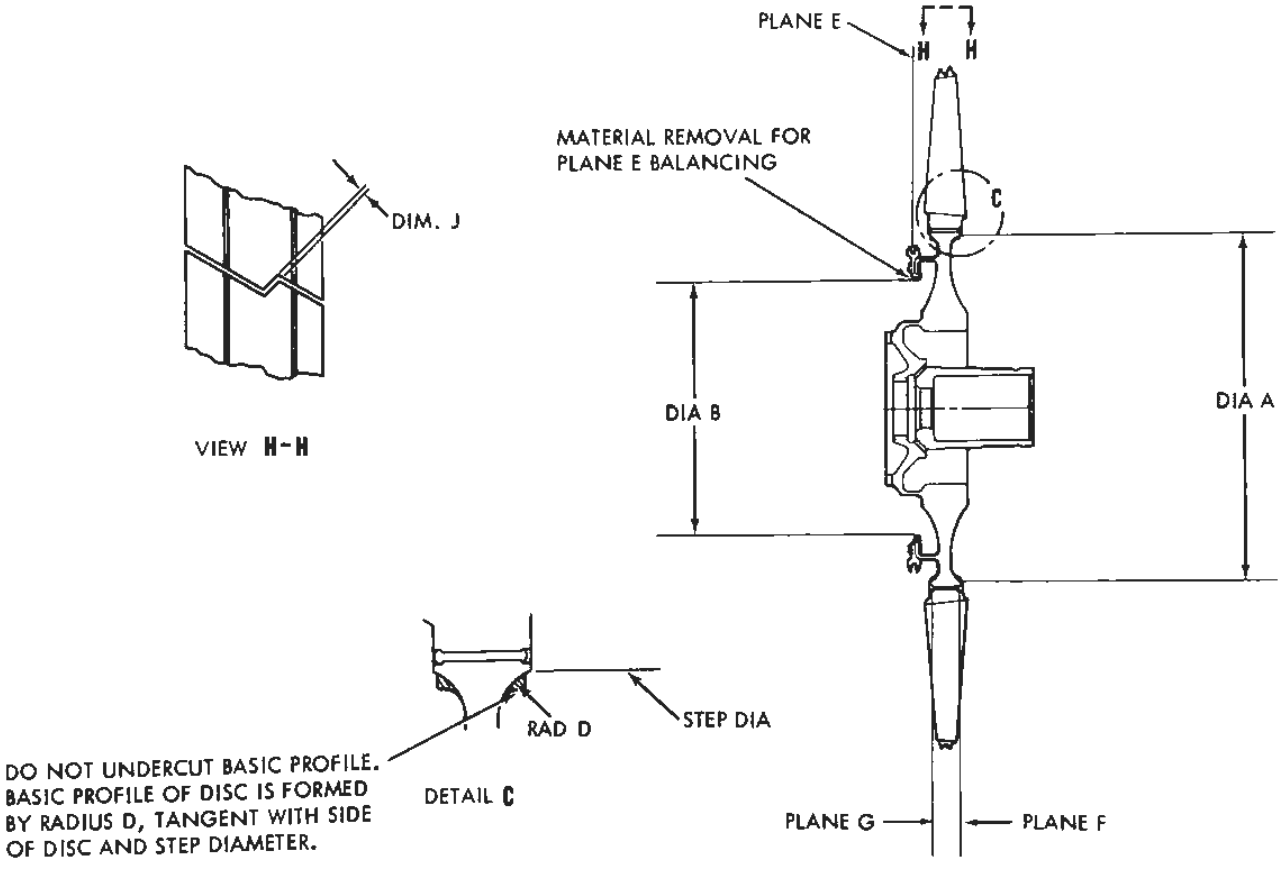
I-48A-248R1


MATERIAL MAY BE REMOVED EQUALLY FROM BOTH SIDES IN SHADED AREA. DO NOT UNDERCUT BASIC PROFILE. BASIC PROFILE OF DISC IS FORMED BY RADIUS C, TANGENT WITH SIDE OF DISC AND STEP DIAMETER.
H
H
PLANE M
DIA A
B
STEP DIA
RADIUS C
DETAIL B
DIM. J
VIEW H-H

A	C	J
8.561 IN. MAX	0.260 IN. MIN	0.010 IN. MAX

I-48A-247R1

Low Pressure Second Stage Turbine Rotor Assembly Repair
Figure 215



A	B	D	J
8.055 IN. MAX	5.99 IN. MAX	0.435 IN. MIN	0.010 IN. MAX

1-48A-246R2

Low Pressure Third Stage Turbine Rotor Repair
Figure 216

4. B. (5) (e) Inspect flared head of newly installed rivets in accordance with Figure 217. Replace rivets not meeting inspection requirements.

(f) Check blade retention at location of at least four newly installed rivets on each rotor assembly as follows.

1) Install rotor assembly in holder portion of 294125-1 holder and gage.

2) Using standard arbor or hydraulic press, momentarily apply 300-pound load at center of fir tree area above each newly installed rivet with brass stylus of force gage portion of 294125-1 holder and gage. If any blade movement results from loading, replace all newly installed rivets on applicable rotor assembly and repeat blade retention check.

(6) Balance first stage turbine rotor assembly. (See figure 214.)

NOTE: Rotor assemblies require balancing following blade replacement or to meet requirements of 1, Removal/Installation (step C.(1)).

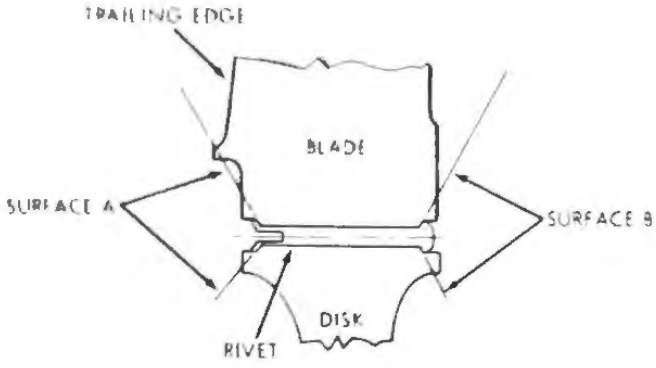
(a) Place rotor assembly between 290702-1 and 290701-1 couplings and secure with 290566-6 tie bolt and 290565-1 nut.

(b) Install rotor assembly and couplings in standard balancing machine.

(c) Dynamically balance rotor assembly on curvic couplings to an accuracy of 0.0154 ounce-inch in Plane E as designed. If unbalance is greater than 0.3 ounce-inch in Plane E, reposition blades for optimum balance prior to any grinding of disc.

(d) Material may be removed from areas as designated. Use care not to undercut basic profile, Radius C, of disc. All places where material is removed for balancing shall fair smoothly. Material removal shall leave no corners or edges sharper than 0.125 inch radius and shall have a surface finish of AA63 or better.

(e) Remove rotor assembly from standard balancing machine and 290702-1 and 290701-1 couplings, 290566-6 tie bolt, and 290565-1 nut.

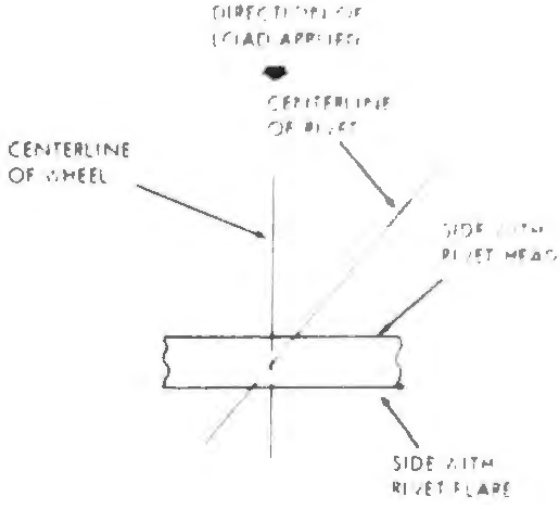


INSPECT SURFACES A AND B WHICH WILL BE IN CONTACT WITH RIVET HEADS AND FLARES. MATERIAL CUTS OR MARRING ON THESE SURFACES ON EITHER DISK OR BLADE IS NOT ACCEPTABLE.

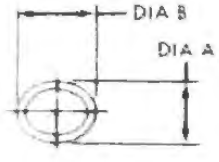
RINGED RIVET HEADS RESULTING FROM MISMATCH BETWEEN SPHERICAL RIVET HEAD AND SUPPORT ARE NOT ACCEPTABLE IF DEEPER THAN 0.005 INCH.

RIVET FLARE SHALL BE FREE FROM CRACKS UNDER VISUAL INSPECTION.

FLATTENED RIVET HEADS ARE ACCEPTABLE PROVIDED THE FLAT IS WITHIN THE CONFINES OF THE SPHERICAL RADIUS OF THE RIVET HEAD.

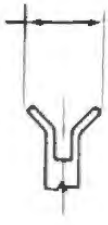


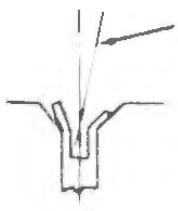
VERIFY BLADE RETENTION LOAD. WITH DISC SUPPORTED, APPLIED LOAD SHALL BE IMPOSED AS INDICATED. BLADE SHALL BE CAPABLE OF MEETING 300 POUND MINIMUM RETENTION LOAD.



RIVET FLARE DIAMETERS A AND B SHALL BE WITHIN 0.015 INCH AND DIAMETER A SHALL NOT BE LESS THAN MINIMUM ALLOWABLE OUTSIDE DIAMETER.

THE OUTSIDE DIAMETER OF THE RIVET FLARE SHALL BE 0.090 INCH MINIMUM.





MALFORMED FLARES WITH MISALIGNMENT AS DETERMINED BY VISUAL INSPECTION ARE NOT PERMITTED

F-48A-165R1

LP Turbine Rotor Assembly Rivet Inspection
Figure 217

4. B. (7) Balance second stage turbine rotor assembly. (See figure 215.)

NOTE: Rotor assemblies require balancing following blade replacement or to meet requirements of 1, Removal/Installation (step C.(1)).

(a) Place rotor assembly between 290702-1 and 290701-1 couplings and secure with 290566-7 tie bolt and 290565-1 nut.

(b) Install rotor assembly and couplings in standard balancing machine.

(c) Dynamically balance rotor assembly on curvic couplings to an accuracy of 0.020 ounch-inch in Plane M as designated. If unbalance is greater than 0.3 ounce-inch in Plane M reposition blades for optimum balance prior to any grinding of disc.

(d) Material may be removed from areas designated. Use care not to undercut basic profile, Radius C, of disc. All places where material is removed for balancing shall fair smoothly. Material removal shall leave no corners or edges sharper than 0.125 inch radius and shall have a surface finish of AA63 or better.

(e) Remove rotor assembly from standard balancing machine and 290702-1 and 290701-1 couplings, 290566-7 tie bolt, and 290565-1 nut.

(8) Balance third stage turbine rotor assembly. (See figure 216.)

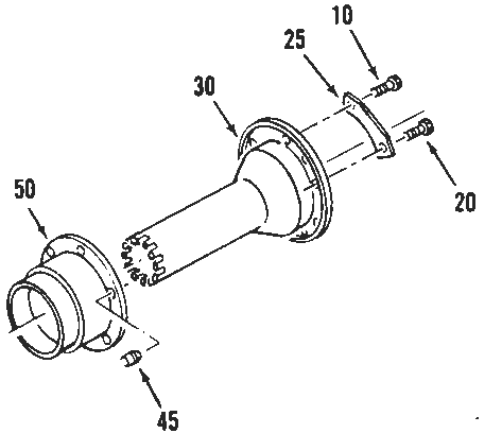
NOTE: Rotor assemblies require balancing after blade replacement or to meet requirements of 1, Removal/Installation (step C.(1)).

(a) Place rotor assembly on 290701-1 coupling and 290704-1 or 290704-2 adapter. Secure with 290566-8 tie bolt and 290565-1 nut.

(b) Install rotor assembly and balancing coupling and adapters in standard balancing machine.

4. B. (8) (c) Dynamically balance rotor assembly on curvic coupling and shaft outside diameter to an accuracy of 0.020 ounce-inch in Plane E and 0.030 ounce-inch in Plane F as designated. Material removal
R is permitted from Plane E and Plane F for this balancing. If unbalance is greater than 0.3 ounce-inch in Plane F, reposition blades for optimum balance prior to any grinding on disc. All places where material is removed for balance shall fair smoothly. Material removal shall leave no corners or edges sharper than 0.125 inch radius and shall have a surface finish of AA63 or better.

(d) Remove rotor assembly from standard balancing machine and 290701-1 coupling, 290704-1 or 290704-2 adapter, 290566-8 tie bolt, and 290565-1 nut.



E-48A-539

10. BOLT (IPC FIG. 101)
20. BOLT
25. RETAINER PLATE
30. SHAFT COUPLING HALF
45. PRESSED-IN NUT
50. ROTOR SEAL

Low Pressure Shaft and Seal Assembly
Figure 218

4. B. (9) Replace seal portion of shaft and seal assembly when abradable seal is damaged beyond limits specified as follows.

NOTE: Replacement of any component of shaft and seal assembly requires rebalancing. Shaft and seal assembly is balanced by orientation of parts (including bolts) on shaft coupling half. Note position of each part removed in relation to remainder of assembly as an aid to balancing at reassembly.

Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(a) Remove bolts, retainer plates, and seal rotor from shaft coupling half. (See figure 218.)

NOTE: Do not remove pressed-in nuts unless damage is indicated by inspection. If replacement is required, replace in accordance with good shop practice.

(b) Remove damaged rotor seal.

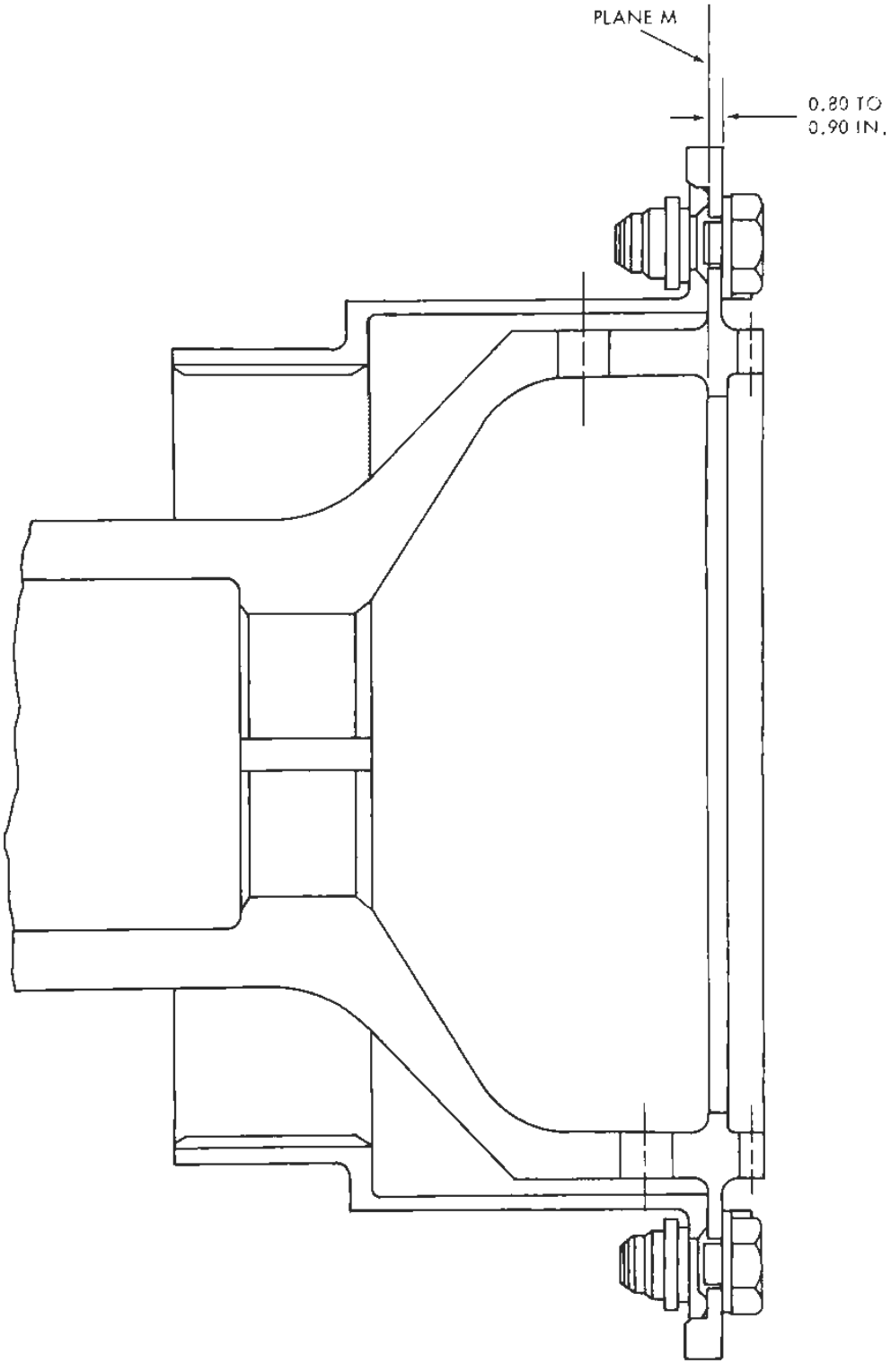
(c) Assemble new seal rotor, new retainer plates and bolts on shaft coupling half. Orient parts as noted at disassembly. Tighten bolts to torque of 30 inch-pounds and bend up tabs on plates to lock bolts.

(d) Balance low pressure shaft and seal assembly as follows. (See figure 219).

1) Install 290562-1 and 290701-1 couplings on curvic couplings of shaft coupling half and secure with 290566-9 tie bolt and 290565-1 nut. Install assembly on standard balancing machine.

2) Dynamically balance shaft and seal assembly to an accuracy of 0.02 ounce-inch in Plane M as designated. Rotate shaft within seal and position different length bolts on assembly to obtain required balance.

3) Remove shaft and seal assembly from standard balancing machine and 290562-1 and 290701-1 couplings, 290566-9 tie bolt, and 290565-1 nut.



1-48A-1

Balancing Low Pressure Shaft and Seal Assembly
Figure 219

TURBINE INTERSTAGE TRANSITION DUCT INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Special Tools, Fixtures and Equipment

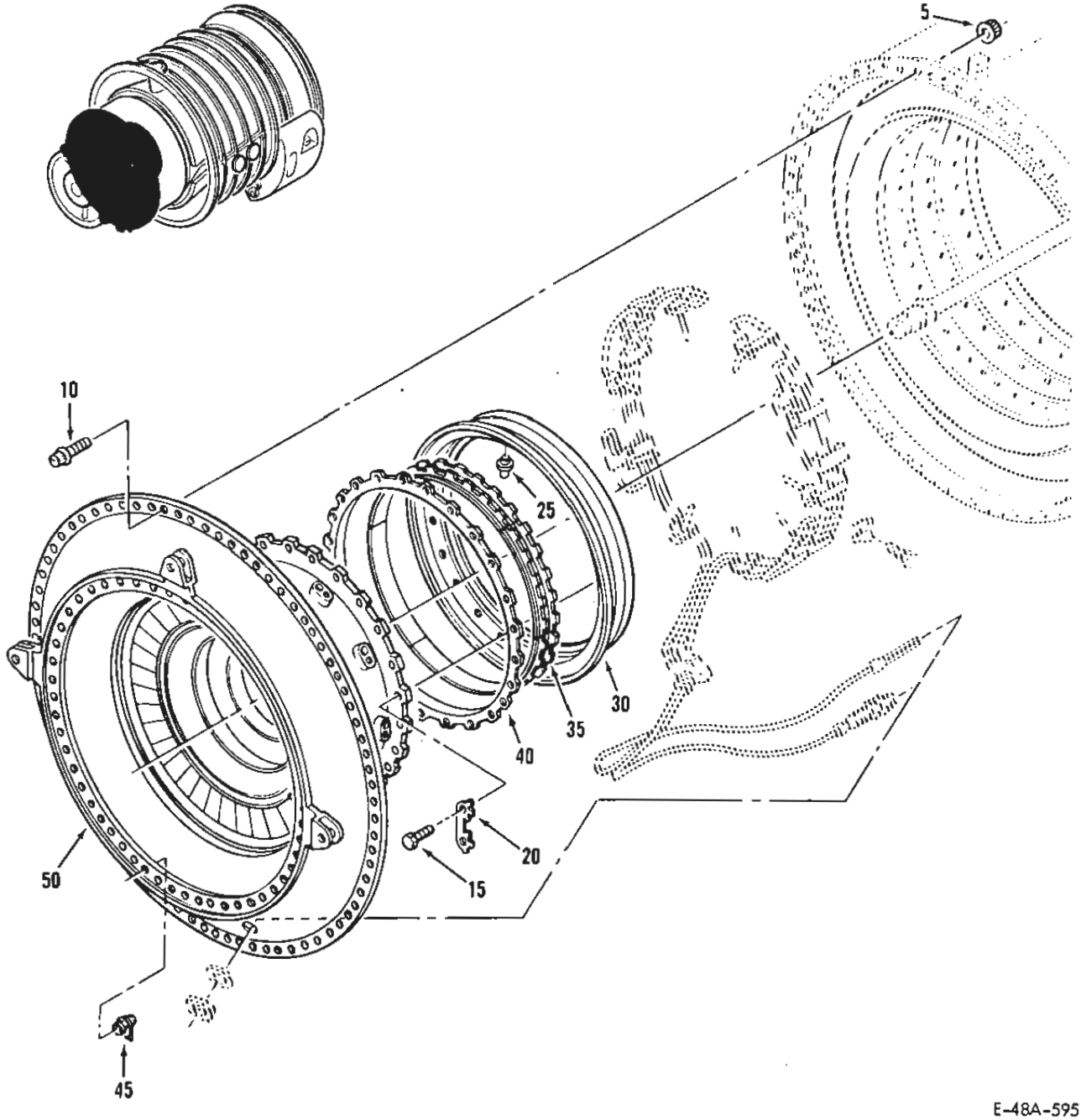
Item No.	Nomenclature	Use	Source Part No.
NOTE: Equivalent substitutes may be used for listed items.			
1.	Interstage Duct Pilot	Guides interstage duct assembly.	289818-1

Table 202. Materials and Compounds

Material or Compound	Manufacturer
CAUTION: ANY SUBSTITUTES USED FOR LISTED INDUSTRIAL MARKING INK OR YELLOW CHINA MARKER SHALL CONTAIN NO CARBON.	
NOTE: Equivalent substitutes may be used for listed items.	
High temperature compound (Fel-Pro C5-A)	Fel-Pro Inc, Div of Felt Products Mfg Co, 7450 N McCormick Blvd, Skokie, IL 60076
Industrial marking ink (Violet, No. 127-1/2)	Pannier Corp, 207 Sandusky St. Pittsburgh, PA 15212
Yellow china marker (No. 170T)	Blaisdell Pencil Co, Philmont Rd, Bethagres, PA 19006

A. Remove Transition Duct (See Figure 201)

(1) Remove oil tube assemblies connected at bosses on right side and bottom of thrust and exhaust nozzle in accordance with 79-20-04, MAINTENANCE PRACTICES.



Turbine Interstage Transition Duct Installation
Figure 201

1. A. (2) Remove N1 transducer access cover plate in accordance with 77-10-03, MAINTENANCE PRACTICES.

(3) Remove rear turbine bearing oil tubes in accordance with 79-20-05, MAINTENANCE PRACTICES.

(4) Remove hardware securing thermocouple harness and N1 transducer leads in accordance with 72-50-03, MAINTENANCE PRACTICES.

(5) Remove N1 transducer installation in accordance with 77-10-03, MAINTENANCE PRACTICES.

(6) Prepare for removal of low pressure turbine module in accordance with steps 1.A.(6) through 1.A.(11) only of 72-50-04, MAINTENANCE PRACTICES.

(7) Remove low pressure turbine roller bearing in accordance with 72-50-01, MAINTENANCE PRACTICES.

R (8) Remove thrust and exhaust nozzle in accordance with steps 1.A.(10) through 1.A.(10) only of 72-50-02, MAINTENANCE PRACTICES.

(9) Remove low pressure turbine module.

(10) Remove bolts securing transition duct to plenum.

(11) Remove mounting brackets and related hardware from outer bolt circle of transition duct in accordance with 72-50-03, MAINTENANCE PRACTICES.

KEY TO FIGURE 201

5. NUT (IPC FIG. 107)
R 10. BOLT
15. BOLT
20. KEY WASHER
*25. PIN
30. RETAINING SLEEVE
35. SHROUD SEGMENT
40. TURBINE SHROUD FLANGE
45. NUT
50. TRANSITION DUCT

*NOT DISASSEMBLED AT MAINTENANCE LEVEL

1. A. (12) Remove transition duct with assembled parts.

R (13) Remove thermocouple harness installation in accordance with 77-20-01, MAINTENANCE PRACTICES.

(14) Remove bolts and key washers securing turbine shroud flange to transition duct. Discard bolts and key washers.

(15) Remove retaining sleeve.

(16) Remove shroud segment and turbine shroud flange.

B. Install Transition Duct (See Figure 201)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Install turbine shroud flange, shroud segment and retaining sleeve. Coat threads of bolts with high temperature compound (Fel-Pro C5-A) and secure shroud flange to transition duct with new bolts and new key washers. Tighten bolts (15) to torque of 45 inch-pounds, and bend locking tabs of key washers against flats of bolt heads.

R (2) Install thermocouple harness installation in accordance with 77-20-01, MAINTENANCE PRACTICES.

(3) Coat threads of bolts (10) with high temperature compound (Fel-Pro C5-A).

(4) Position 289818-1 pilot over lands of rotor seal.

(5) Install transition duct with assembled parts.

(6) Install mounting brackets and related hardware on outer bolt circle of transition duct in accordance with 72-50-03, MAINTENANCE PRACTICES.

(7) Secure transition duct with bolts and nuts.

(8) Remove 289818-1 pilot.

(9) Tighten bolts (10) securing transition duct to torque of 80 inch-pounds.

(10) Install low pressure turbine module in accordance with steps 1.D.(1) through 1.D.(3) only of 72-50-04, MAINTENANCE PRACTICES.

1. B. (11) Install thrust and exhaust nozzle in accordance with steps 1.B.(5) and 1.B.(6) only of 72-50-02, MAINTENANCE PRACTICES.

(12) Install low pressure turbine roller bearing in accordance with 72-50-01, MAINTENANCE PRACTICES.

(13) Complete installation of low pressure turbine module in accordance with steps 1.D.(6) through 1.D.(12) only of 72-50-04, MAINTENANCE PRACTICES.

(14) Install N1 transducer installation (except for transducer access cover plate) in accordance with 77-10-03, MAINTENANCE PRACTICES.

(15) Install hardware securing thermocouple harness and N1 transducer leads in accordance with 72-50-03, MAINTENANCE PRACTICES.

(16) Install rear turbine bearing oil tubes in accordance with 79-20-05, MAINTENANCE PRACTICES.

(17) Install N1 transducer access cover plate in accordance with 77-10-03, MAINTENANCE PRACTICES.

(18) Install oil tube assemblies which connect at bosses on right side and bottom of thrust and exhaust nozzle in accordance with 79-20-04, MAINTENANCE PRACTICES.

2. Inspection/Check

A. Inspect Transition Duct (With Low Pressure First Stage Turbine Nozzle)

(1) Inspect transition duct wall and mounting flange for distortion.

(2) Inspect nozzle area of transition duct for cracks or distortion. Cracks or distortion are not allowed.

(3) Inspect abradable seal diameter mating with knife edge seals for damage to contact path, both axially and on circumference. Slight chips and nicks on the seal edges are acceptable. Cracks that do not extend beyond the first knife-edge seal groove are acceptable. Flaking and chipping that do not extend beyond all knife-edge seal grooves are acceptable. Eccentric grooved patterns in abradable material seal area are acceptable but groove depth shall not exceed 0.030 inch. Refer to 70-00-00, GENERAL - STANDARD PRACTICES for general requirements.

R 2. A. (4) Inspect support/stator braze joint (figure 202) in duct. A complete separation (360 degrees) of braze joint is acceptable if resulting gap does not exceed 0.005 inch at any point. Greater gap dimensions are allowable for lesser lengths of separation as shown. Maximum allowable accumulative crack area is 0.143 square inch (crack length multiplied by crack width). Maximum allowable aft movement of inner sheet metal on support shall not exceed 0.020 inch relative to stator.

(5) Replace transition duct, if inspection requirements of steps (1) through (4) are not met.

(6) Inspect shroud segment for rub damage. Light rub damage is acceptable. Replace shroud segment if excessive rub damage is evident.

(7) Check nuts on transition duct for security, stripped, or damaged threads. Some radial movement is acceptable. Stripped or damaged threads are not acceptable. Refer to 4, Approved Repairs if damage is evident.

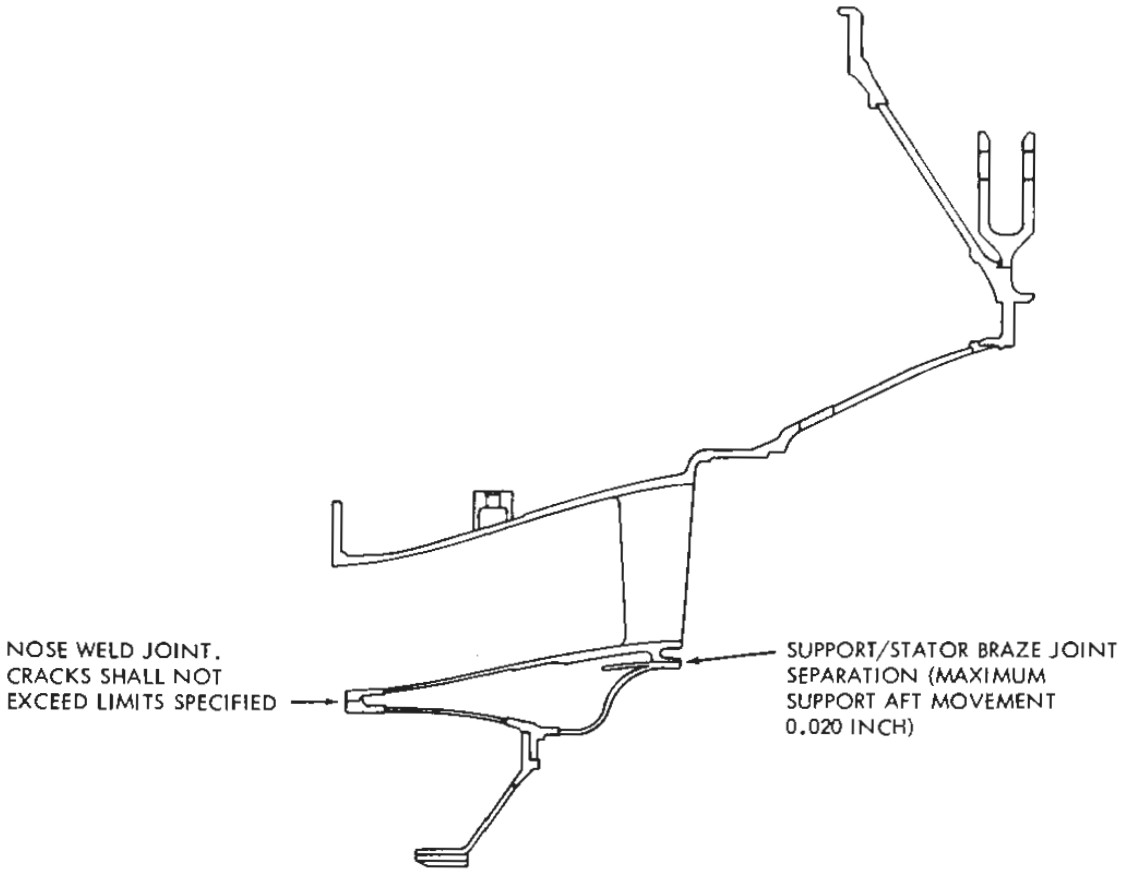
R (8) Inspect coated surfaces on low pressure first stage nozzle vanes for raised wrinkling, or blistering of coating material. Raised wringling or blistering of coating material not acceptable.

(9) Inspect first stage nozzle vane of transition duct. (See figure 203.) Cracks in vanes are acceptable if crack length does not exceed 0.250 inch, crack width does not exceed 0.010 inch, no more than two cracks on any one vane, and, when two cracks occur on one vane, cracks do not intersect or occur in an intersecting plane. Inspect vane surfaces for deformation and leading and trailing edge nicks or dents. Refer to 4, Approved Repairs for repair of vane surfaces.

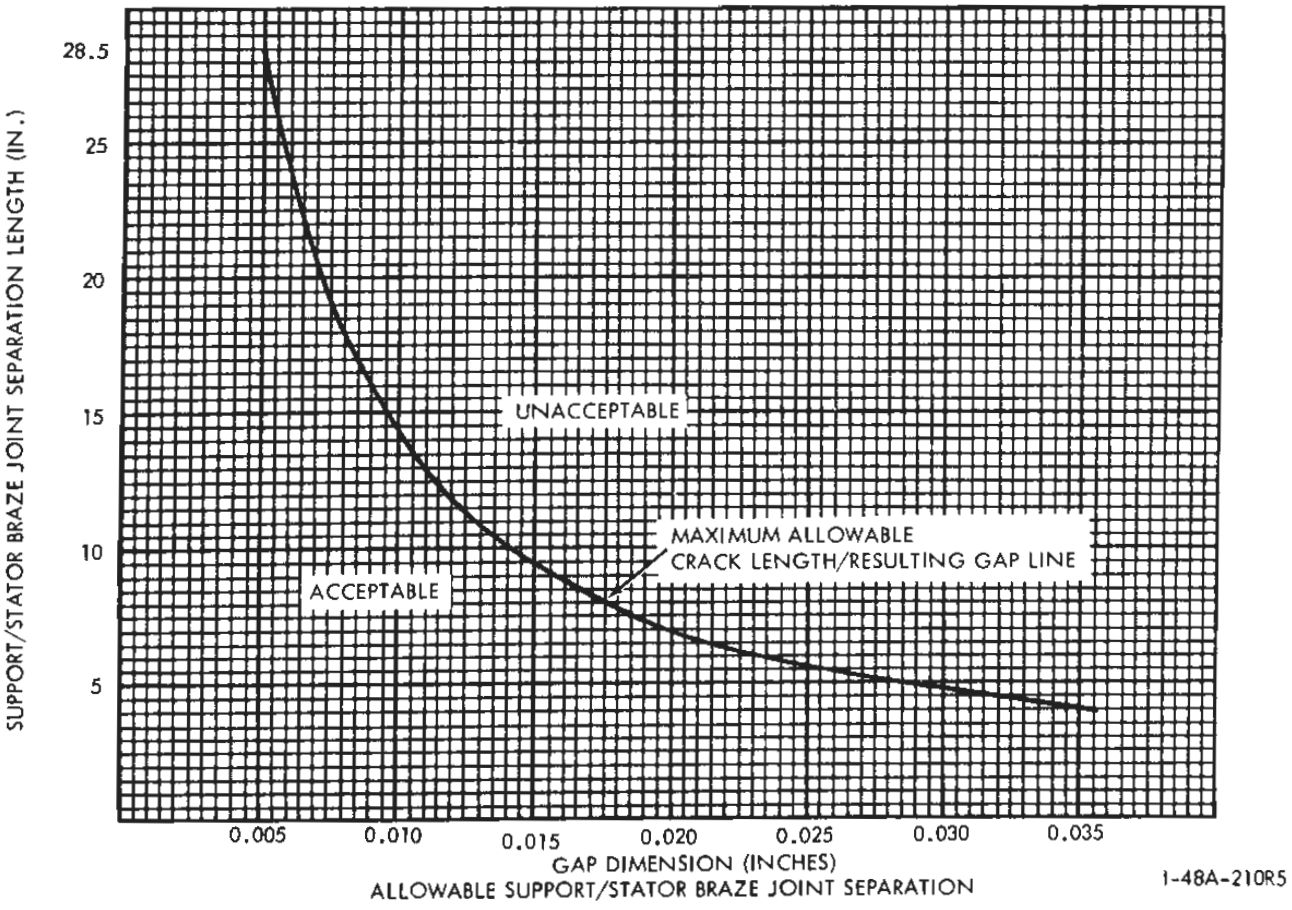
(10) Inspect for cracks on nose weld joint (figure 202) (surface with small diameter cooling holes). A maximum of two circumferential cracks (along cooling hole circle) are acceptable if cracks are separated by at least 90 degrees and length of each crack is encompassed by no more than two cooling holes. Any cracks extending radially are not acceptable.

2. A. (11) Inspect shroud area (for low pressure first stage turbine rotor assembly blades) on transition duct for presence of metal build-up due to blade rub. Refer to 4, Approved Repairs if metal build-up is apparent. Minor grooving in parent metal of shroud (caused by blade rub) is acceptable.

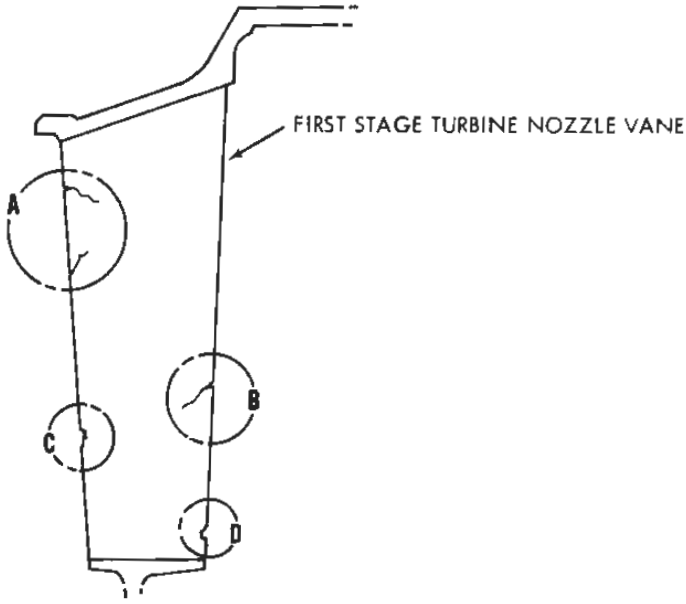
R (12) Inspect retaining sleeve for cracks or burning; ensure
R pin is secure. Cracks, burning or loose pin not
R acceptable.


NOSE WELD JOINT. CRACKS SHALL NOT EXCEED LIMITS SPECIFIED
SUPPORT/STATOR BRAZE JOINT SEPARATION (MAXIMUM SUPPORT AFT MOVEMENT 0.020 INCH)

R

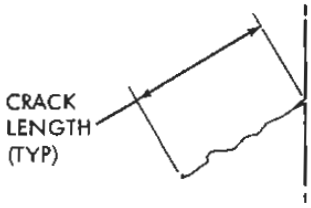


Inspection of Transition Duct Nose Weld Joint and Support/Stator Braze Joint
Figure 202

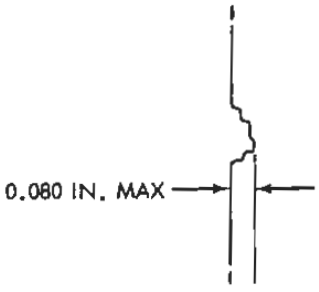


EXAMPLE OF CRACKS ON INTERSECTING PLANE (NOT ACCEPTABLE)

DETAIL A

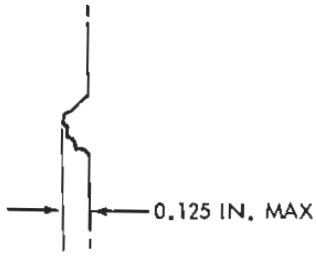


DETAIL B



EXAMPLE OF REPARABLE LEADING EDGE NICK

DETAIL C



EXAMPLE OF REPARABLE TRAILING EDGE NICK

DETAIL D

MORE THAN TWO CRACKS, OR CRACKS ON INTERSECTING PLANE, ARE NOT ACCEPTABLE.

CRACK LENGTH SHALL NOT BE GREATER THAN 0.250 INCH AND CRACK WIDTH SHALL NOT EXCEED 0.010 INCH.

I-48A-366

Nozzle Vane Repair Limits
Figure 203

3. Cleaning/Painting

A. Clean Parts

Clean parts as specified in Table 203 in accordance with cleaning methods provided in 72-00-00, GENERAL - CLEANING/PAINTING.

Table 203. Cleaning Methods

Figure No.	Item No.	Nomenclature	Cleaning Methods 1	2	3	4	5	6	7	8	9	10	11	12
All		Standard metallic hardware	X	X										
201	15	Bolt	X	X										
	25 through 30	Retaining Sleeve	X	X							X			
	35	Shroud Segment	X	X							X			
	40	Turbine Shroud Flange	X	X							X			
	45, 50	Transition Duct		X										

4. Approved Repairs

Table 204. Special Tools, Fixtures and Equipment

Item No.	Nomenclature	Use	Source Part No.
NOTE: Equivalent substitutes may be used for listed item.			
1.	Nutplate Wrench Set	Used to install nuts on transition duct.	293328-1

A. Remove and Replace Damaged Nuts on Transition Duct

(1) Remove damaged nuts on transition duct using a punch.

(2) Install new nut in transition duct and secure using 293328-1 nutplate wrench set.

4. B. Repair First Stage Turbine Nozzle of Transition Duct

(1) Blend leading and trailing edge nicks and dents on nozzle vanes to remove damaged material when repair can be accomplished within the following limits. (See figure 203.)

NOTE: Do not repair cracks by blending. When crack propogates from a leading or trailing edge nick, blend only to repair nick damage.

(a) Provided no blending is required within 0.10 inch of inner or outer vane base on no more than 15 vanes.

(b) Provided damaged leading or trailing edge requires no more than one blend.

(c) Provided no more than 20 vanes require blending.

(d) Provided depth of blend required does not exceed 0.080 inch on leading edge.

(e) Provided depth of blend required does not exceed 0.125 inch on more than five trailing edges, and depth of blend required does not exceed 0.080 inch on remainder of trailing edges to be blended.

(f) Provided blend lengths are at least five times blend depth.

(g) Provided all areas where material is removed by blending fair smoothly with surface finish of AA125 or better.

(2) Blend nicks or dents on convex or concave surfaces of vanes to remove damaged material when repair can be accomplished within the following limits.

NOTE: Nicks or dents which can be inscribed by a 0.125 inch diameter and less than 0.020 in depth may be disregarded.

(a) Provided no blending is required within 0.10 inch of inner or outer base of vane.

(b) Provided blending does not reduce vane thickness more than one-half of local stock thickness on any vane, and no more than six vanes per nozzle are blended to full depth allowed.

4. B. (2) (c) Provided blending is required for no more than six nicks or dents per vane side, with a separation of at least 0.125 inch between nicks or dents to be blended.

(d) Provided blend lengths are at least five times blend depth.

(e) Provided all areas where material is removed by blending fair smoothly with surface finish of AA125 or better with forward fillet radii 0.07 to 0.11 inch and all other fillet and corner radii 0.02 to 0.08 inch.

(3) When metal build-up is apparent on shroud area (for first stage turbine rotor assembly blades) of transition duct, remove metal build-up by blending.

(4) Perform fluorescent penetrant inspection in accordance with MIL-I-6866 after repair on repaired areas. Cracks are not acceptable.

(5) Replace part that is damaged beyond repair specified.

HIGH PRESSURE TURBINE ROTOR AND NOZZLE ASSEMBLY INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Special Tools, Fixtures and Equipment

Item No.	Nomenclature	Use	Source Part No.
NOTE:	Equivalent substitutes may be used for listed items.		
1.	Shaft Stretcher Fixture Sleeve (component of item 2)	Used on item 2 to stretch HP shouldered shaft.	292032-2
2.	*HP Shaft Stretcher Fixture (with cylinder and pump)	Stretches HP shouldered shaft.	293001-1 or 293001-3
3.	Mechanical Crimper	Used to crimp flange on round nut assembly.	293070-1
4.	Coupling Alignment Gage	Used for replacement of front coupling.	294145-1
5.	Mechanical Decrimper	Used to straighten crimp in round nut flange at disassembly.	294625-1
6.	Driver (Part of 294525-1)	Drives against crimp in round nut.	294625-13

NOTE: *A fluorescent penetrant inspection in accordance with MIL-I-6866, Type I, is required on 292033-2 threaded rod and 290489-2 nut to ensure serviceability at 60 day intervals or after each 100 times fixture is loaded (whichever occurs first). Maintain a permanent record with stretching fixture to record number and dates of fixture loadings and dates of inspections. Life limit of 292033-2 threaded rod and 290489-2 nut is 10,000 fixture loadings. These components shall be replaced at or before reaching life limit.

Table 202. Materials and Compounds

Material or Compound	Manufacturer
CAUTION: ANY SUBSTITUTES USED FOR LISTED INDUSTRIAL MARKING INK OR YELLOW CHINA MARKER SHALL CONTAIN NO CARBON.	
NOTE: Equivalent substitutes may be used for listed items.	
Gear rouge or bearing blue	Commercially available
High temperature compound (Fel-Pro C5-A)	Fel-Pro Inc, Div of Felt Products Mfg Co, 7450 N McCormick Blvd, Skokie, IL 60076
Industrial marking ink (Violet, No. 127-1/2)	Pannier Corp, 207 Sandusky St. Pittsburgh, PA 15212
Solvent, Stoddard (Federal Specification P-D-680, Type I)	Commercially available
Suede brush	Commercially available
Yellow china marker (No. 170T)	Blaisdell Pencil Co, Philmont Rd, Bethagres, PA 19006

1. A. Remove HP Turbine Rotor Nozzle Assembly (See Figure 201)

CAUTION: WHEN COMPONENTS ARE BEING REPLACED AS A RESULT OF MALFUNCTION (I.E., HP TURBINE BLADE FAILURE, HP IMPELLER BLADE FAILURE, MISASSEMBLY DAMAGE, ETC.). INSPECT BOSS WELDS ON COMBUSTION CHAMBER PLENUM CASE (72-00-00, GENERAL - INSPECTION/CHECK, PARAGRAPH 18.)

(1) Remove oil tube assemblies connected to bosses on right side and bottom of thrust and exhaust nozzle in accordance with 79-20-04, MAINTENANCE PRACTICES.

(2) Remove N1 transducer access cover plate in accordance with 77-10-03, MAINTENANCE PRACTICES.

(3) Remove rear turbine bearing oil tubes in accordance with 79-20-05, MAINTENANCE PRACTICES.

1. A. (4) Remove hardware securing thermocouple harness and N1 transducer leads in accordance with 72-50-03, MAINTENANCE PRACTICES.

(5) Remove N1 transducer installation in accordance with 77-10-03, MAINTENANCE PRACTICES.

NOTE: Removal of the low pressure tie rod nut and the high pressure turbine round nut requires a vibration check after re-installation. Refer to 72-00-00, GENERAL - ADJUSTMENT/TEST, paragraph 12.

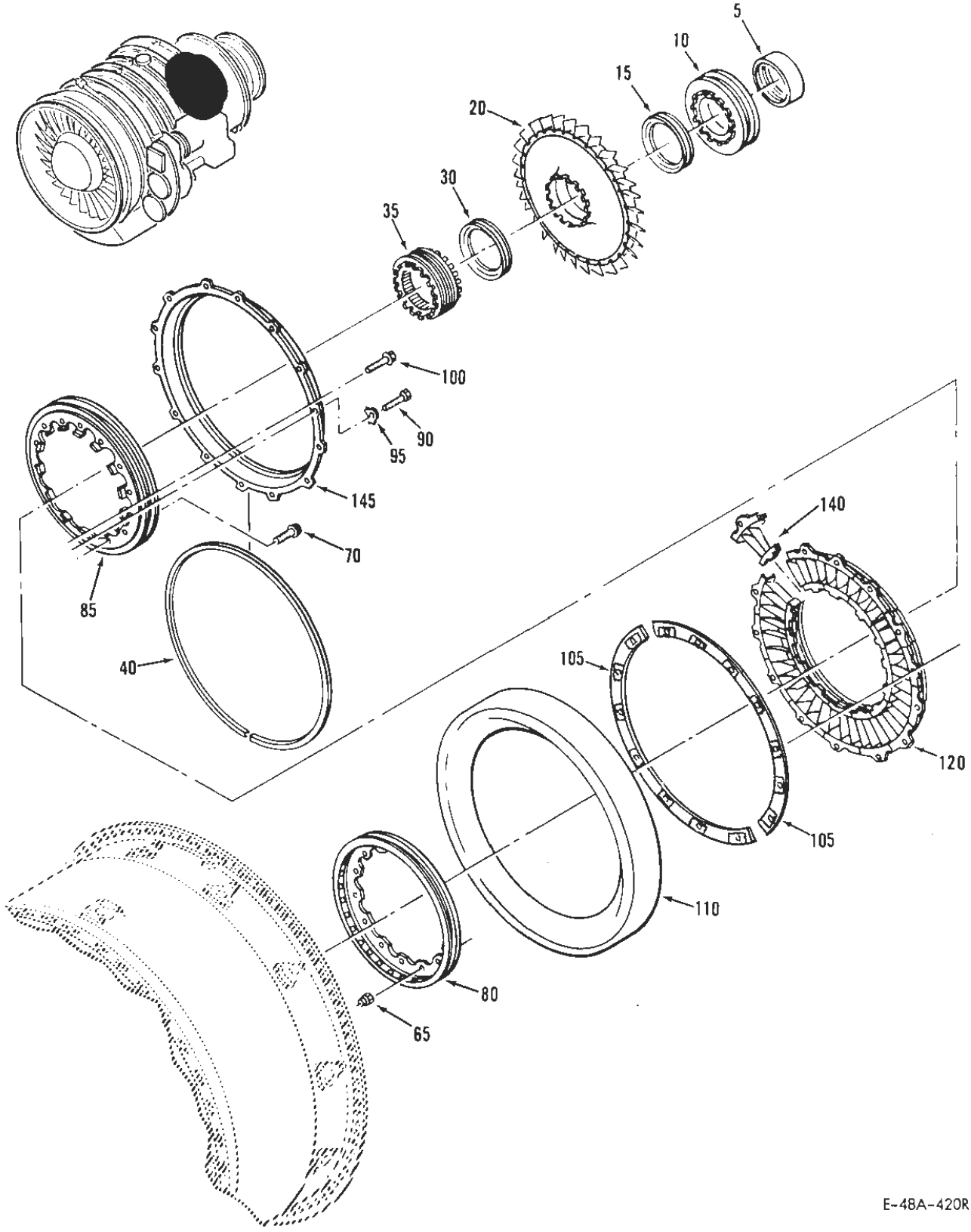
(6) Remove assembled duct-nozzle-low pressure turbine module assembly in accordance with steps 1.A.(8) through 1.A.(15) only of 72-40-02, MAINTENANCE PRACTICES.

NOTE: Dimensions and respective positions recorded in the following steps are for use at reassembly of the high pressure rotating group to ensure correct shaft stretch and radial alignment of curvic coupling teeth. (See table 203.)

Hand load the high pressure rotating group forward (with approximately 15 pounds of force) during all dimensional measurements.

(7) Measure and record Dimension X (on work sheet of table 203) from Surface B on aft surface of aft coupling to Surface A on aft flange on plenum case using a parallel bar. (See figure 202.) Mark coupling at point measurement taken and location of parallel bar on plenum case using yellow china marker (No. 170T) or industrial marking ink (Violet, No. 127-1/2).

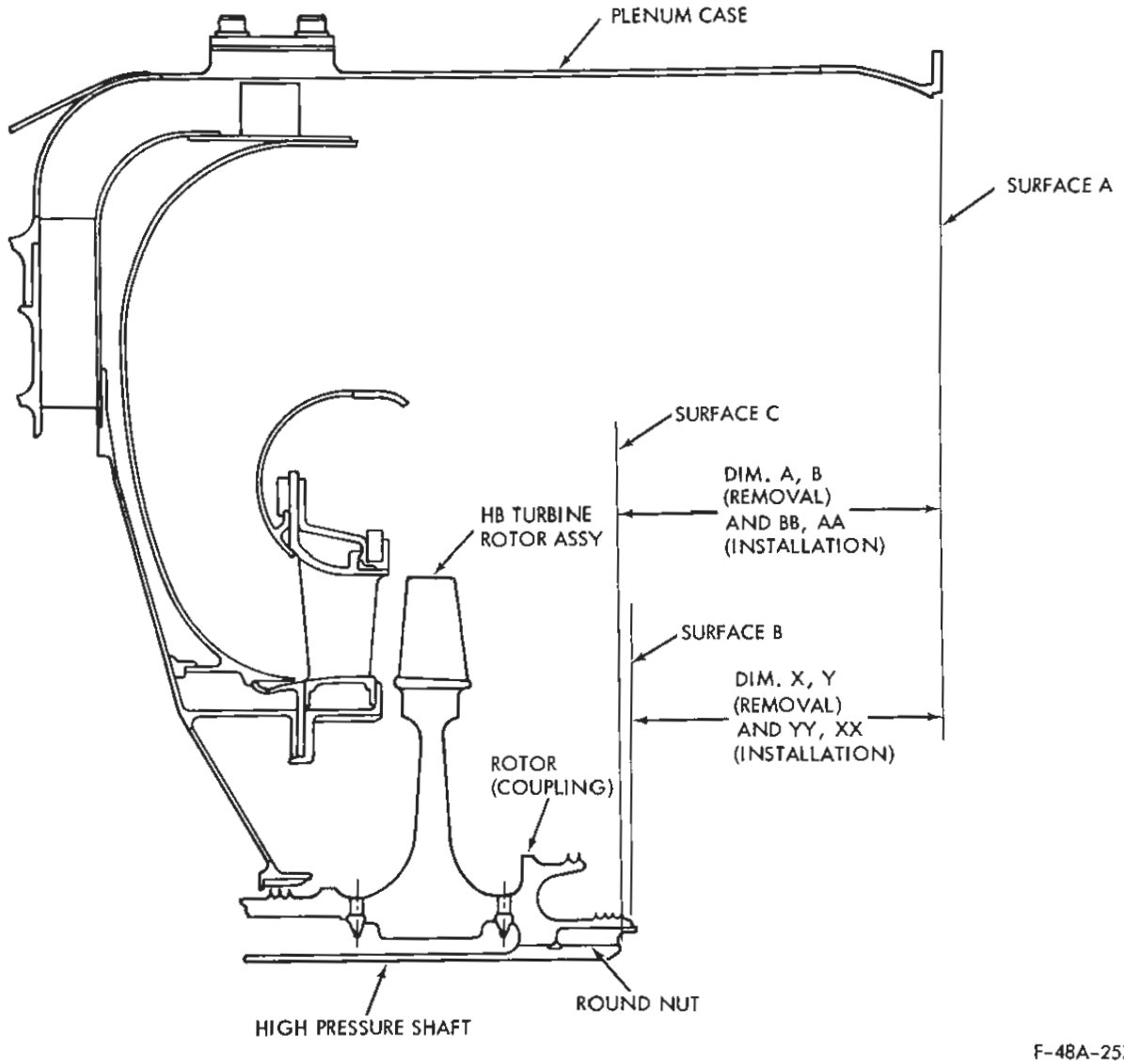
(8) Measure and record Dimension A (on work sheet of table 203) from Surface C on end of high pressure shaft to Surface A on aft flange of plenum case using a parallel bar. (See figure 202.) Mark shaft at point measurement taken and location of parallel bar on plenum case using yellow china marker (No. 170T) or industrial marking ink (Violet, No. 127-1/2).



High Pressure Turbine Rotor and
Nozzle Assembly Installation
Figure 201

KEY TO FIGURE 201

5.	ROUND NUT (IPC FIG. 109)	85.	NOZZLE SUPPORT
10.	SEAL ROTOR	90.	BOLT
15.	SEAL RING	95.	KEY WASHER
20.	HP TURBINE ROTOR ASSY	100.	SHOULDER BOLT
30.	SEAL RING		(PART DELETED)
35.	SEAL ROTOR	105.	RETAINING FLANGE SEGMENT
40.	PISTON RING SEAL	110.	TRANSITION LINER
65.	NUT	120.	NOZZLE SEGMENT
70.	BOLT	140.	NOZZLE SEGMENT
80.	AIRSEAL RING	145.	AIRSEAL SUPPORT



High Pressure Shaft Stretch Measurement
Figure 202

Table 203. HP Shaft Stretch and Curvic Coupling Radial Alignment Worksheet

Date:_____ Engine Serial No:_____ Technician:_____

Para. Ref.	Dimension to be Recorded (Fig. 202)	Surfaces for Measurement (Fig. 202)	Conditions
HP Turbine Removal			
1.A.(7)	Dim. X:_____	A to B	HP shaft stretched.
1.A.(8)	Dim. A:_____	A to C	HP shaft stretched.
1.A.(11)	Dim. Y:_____	A to B	HP shaft unstretched (round nut hand tight).
1.A.(12)	Dim. B:_____	A to C	HP shaft unstretched (round nut hand tight).
HP Turbine Installation			
1.B.(9)	Dim. YY:____	A to B	HP shaft unstretched (round nut hand tight). Dimension YY shall equal Dimension Y, ±0.004* inch.
1.B.(10)	Dim. BB:____	A to C	HP shaft unstretched (round nut hand tight). Dimension BB shall equal Dimension B, ±0.004* inch.
1.B.(13)	Dim. XX:____	A to B	HP shaft stretched. Dimension XX shall equal Dimension X, ±0.004* inch.
1.B.(14)	Dim. AA:____	A to C	HP shaft stretched. Dimension AA shall equal Dimension A, ±0.004* inch.

NOTE: *If components other than those removed are installed, use tolerance of 0.020 inch instead of 0.004 inch for dimension comparison.

Keep worksheets for each HP turbine Removal/Installation performed with permanent engine records.

WARNING: DO NOT STAND BEHIND, ABOVE, OR BELOW SHAFT STRETCH FIXTURE WHEN PRESSURE IS APPLIED TO FIXTURE IN THE FOLLOWING STEPS. A FAILURE OF HIGH PRESSURE SHAFT OF FIXTURE WOULD EXPEL FIXTURE AFT WITH CONSIDERABLE FORCE.

CAUTION: WHEN PERFORMING THE FOLLOWING PROCEDURE, MAKE CERTAIN FORCE SPECIFIED IS NOT EXCEEDED TO ENSURE SHAFT IS NOT OVERSTRETCHED. ENSURE PROPER SPECIAL TOOLING IS USED.

1. A. (9) Loosen round nut as follows using 293001-1 or 293001-3 fixture.

(a) Use 294625-1 decrimper to straighten crimp on round nut flange and allow rotation of round nut as follows.

1) Check tip of 294625-13 driver (part of decrimper) formed by bevel and radius faces of driver. If required, hand finish tip to remove nicks and gouges. (If tip shape cannot be maintained by hand finishing, replace 294625-13 driver of decrimper.)

2) Tighten decrimper on end of high pressure shaft with window and driver of decrimper centered over crimp in flange of round nut. Turn driver of decrimper so flat face of tip faces high pressure shaft and radius face of tip faces crimp in nut flange.

3) Turn hand knob on decrimper to move driver forward, between slot in high pressure shaft and crimp in nut flange, until driver contacts crimp in nut flange.

4) Using wrench, continue rotating hand knob on decrimper to force out crimp in nut flange, but do not extend driver to point that driver bottoms on high pressure shaft.

(b) Ensure 292032-2 sleeve is installed on 293001-1 or 293001-3 fixture.

R (c) Disassemble 293001-1 or 293001-3 fixture to
R separate threaded rod and wrench. Clean threads
R of fixture components and mating threads for fix-
R ture on engine component. Lubricate threads on
R threaded rod of fixture with a light coat of lu-
R bricating compound (liqui-Moly, Grade NV, thread
R compound).

CAUTION: ENSURE ROD PORTION OF FIXTURE ENGAGES A MINIMUM OF FIVE AND ONE-FOURTH THREADS IN INTERNAL BORE OF HIGH PRESSURE SHAFT WHEN PERFORMING THE FOLLOWING STEP TO ENSURE PROPER INSTALLATION OF FIXTURE AND PREVENT DAMAGE TO SHAFT.

R 1. A. (9) (d) Thread rod portion of 293001-1 or 293001-3 fixture into internal threads of high pressure shaft until rod bottoms in shaft, counting turns of thread engage-ment. A minimum number of five and one-fourth turns ensures proper installation of fixture.

(e) Ensure high pressure rotating group does not turn and back rod out one-fourth turn.

(f) Slide wrench portion of fixture forward over rod to engage holes in round nut.

CAUTION: ENSURE WING NUT OF FIXTURE ENGAGES A MINIMUM OF FOUR THREADS WHEN PERFORMING THE FOLLOWING STEP TO ENSURE PROPER INSTALLATION OF FIXTURE.

1. A. (9) (g) Carefully assemble adapter and cylinder assembly of fixture over fixture rod. Secure assembly with fixture bushing and wing nut on end of fixture rod while holding fixture forward against rotating group. Ensure wing nut engages a minimum number of four threads to ensure proper installation of fixture.

(h) Back wing nut out one-half turn from bottoming position.

(i) Use hand pressure to align cylinder assembly of fixture concentrically with fixture rod, then apply sufficient pressure with hydraulic pump of fixture to support cylinder in aligned position.

NOTE: Exceeding maximum specified pressure in the following steps may cause stretch between high pressure shaft threads, causing round nut to be locked.

(j) Slowly continue to apply pressure with hydraulic pump of fixture while maintaining loosening (counterclockwise) pressure on round nut with fixture wrench, using a 3/8 x 8 inch dowel pin inserted in one of the fixture wrench insertion holes, until nut loosens or fixture pressure gage indicates 6100 psig.

CAUTION: WHEN REQUIRED TO INCREASE HYDRAULIC PRESSURE ON FIXTURE AS SPECIFIED IN THE FOLLOWING STEP, DO NOT EXCEED 7450 PSIG ON FIXTURE PRESSURE GAGE.

(k) Turn fixture wrench to rotate round nut counterclockwise. If round nut will not loosen, relieve hydraulic pressure on fixture and repeat steps (i) through (k) to loosen nut. If round nut will not loosen after four repetitions, repeat steps (i) through (k) with hydraulic pressure increased 50 psig over previously used hydraulic pressure. Continue repetitions until round nut is loosened, but do not exceed 7450 psig on fixture pressure gage.

1. A. (9) (l) Turn fixture wrench to rotate round nut counterclockwise three turns.

(m) Slowly relieve hydraulic pressure, then remove fixture.

(10) Mark relative position of aft coupling and rotor assembly to high pressure shaft using yellow china marker (No. 170T) or industrial marking ink (Violet, No. 127-1/2).

NOTE: Hand load the high pressure rotating group forward (with approximately 15 pounds of force) during all dimensional measurements.

(11) Measure and record Dimension Y (on work sheet of table 203) from Surface B on aft surface of aft coupling to Surface A on flange on plenum case using a parallel bar. (See figure 202.) Ensure measurement is taken from points marked during initial measurement.

(12) Measure and record Dimension B (on work sheet of table 203) from Surface C on end of high pressure shaft to Surface A on aft flange of plenum case using a parallel bar. (See figure 202.) Ensure measurement is taken from same points marked during initial measurement.

R R R R CAUTION: USE CARE WHEN HANDLING COMPONENTS WITH CURVIC COUPLINGS AND KNIFE EDGES TO AVOID DAMAGE. REFER TO 70-00-00, 6, COMPONENT HANDLING.

NOTE: A record of cycles as specified in Service Bulletin 72-3001 shall be maintained on rotor (disc) of rotor assembly throughout life of part.

(13) Remove round nut, aft seal rotor (aft coupling), aft seal ring, rotor assembly and forward seal ring. Do not disengage forward seal rotor (front coupling) from splines on high pressure shaft if possible, as relationship of splines to curvic coupling will have to be re-established, step B.(7).

NOTE: When index marks specified in the following step are not made prior to initial disengagement of internal splines on front coupling, special measurements are required at reassembly (step B.(7)).

(14) Mark relative position of front coupling and high pressure shaft on splines using yellow china marker (No.

170T) or industrial marking ink (Violet, No. 127-1/2) to aid reassembly.

NOTE: The following step is required only if front coupling to be removed from engine will not be reinstalled and a new or replacement front coupling will be installed in its place.

1. A. (15) Measure and record position of front coupling on shaft (Dimension A, figure 203). Identify front coupling as REMOVED using yellow china marker (No. 170T).

NOTE: Do not remove front coupling unless replacement is necessary or to facilitate other maintenance.

(16) Remove front coupling.

NOTE: Seal ring removed in the following step may be one piece or may consist of an outer backing ring and an inner split ring.

(17) Remove piston seal ring from airseal support of high pressure turbine nozzle assembly.

(18) Mark relative positions of HP turbine nozzle assembly components, airseal ring, nozzle support, retaining flange segments, transition liner, nozzle segments, and airseal support, using yellow china marker (No. 170T) or industrial marking ink (Violet, No. 127-1/2) to aid reassembly. Remove nuts, bolts, and key washers, then separate HP turbine nozzle assembly components.

1. B. Install HP Turbine Rotor and Nozzle Assembly (See Figure 201)

CAUTION: WHEN REPLACEMENT COMPONENTS ARE BEING INSTALLED AS A RESULT OF MALFUNCTION (I.E., HP TURBINE BLADE FAILURE, HP IMPELLER BLADE FAILURE, MISASSEMBLY DAMAGE, ETC.), INSPECT BOSS WELDS ON COMBUSTION CHAMBER PLENUM CASE (72-00-00, GENERAL - INSPECTION/CHECK, PARAGRAPH 18.)

R R R R USE CARE WHEN HANDLING COMPONENTS WITH CURVIC COUPLINGS AND KNIFE EDGE SEALS TO AVOID DAMAGE. REFER TO 70-00-00, 6, COMPONENT HANDLING.

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Assemble high pressure turbine nozzle assembly as follows.

(a) Place transition liner on a bench with smaller diameter surface down.

(b) Match offset in bolt pattern (two holes are closer together) in nozzle support and airseal ring. Temporarily attach nozzle support to airseal ring with three bolts and nuts. Do not tighten nuts at this time.

(c) Place assembled airseal ring and nozzle support (with nozzle support facing up) inside transition liner with offset in bolt hole pattern at the 12 o'clock position.

CAUTION: WHEN PERFORMING THE FOLLOWING STEP ENSURE RETAINING FLANGE SEGMENTS ARE ORIENTED SO WELDED NUT PLATES WILL FACE AWAY FROM NOZZLE SEGMENTS.

(d) Place each retaining flange segment in transition liner with step in nut plate of retaining flange segment facing flange in transition liner. Start each retaining flange segment at the two o'clock position.

R NOTE: The following steps may not reinstall nozzle segments in positions indexed at disassembly of high pressure turbine nozzle assembly.

R If any nozzle segment removed at disassembly is not to be reinstalled, ensure replacement nozzle segment part number is the same as the replaced part to ensure proper effective flow area (AE) is maintained. Nozzle Segment Part No. 3072594-1, 3071767-1, and 3072244-1 provide high, middle and low range values of AE, respectively. The square-inch value of AE as measured by the manufacturer is etched on the nozzle segment.

R 1. B. (1) (e) Establish required positions for nozzle segments within high pressure turbine nozzle assembly by completing data sheet of Table 203A. For any nozzle segment where effective flow area (AE) is not legibly identified, group segment with segments of same part number in position number list to assure a higher-to-lower AE sequence in list.

R (e1) Install two-vane nozzle segment (Part No. 3071767-2) so that tab on inboard side of nozzle segment is engage in slot of assembled airseal ring and nozzle support. Proper slot for tab of two-vane segment is at clockwise side of offset in slot pattern (Position No. 1, figure 202A).

R (e2) Install three-vane nozzle segments in positions illustrated in Figure 202A in accordance with position numbers assigned on data sheet (table 203A), with tabs on inboard side of segments engaged in slots of assembled airseal ring and nozzle support. Arrangement of segments established by data sheet and Figure 202A provides a high-to-low-to-high progression of AE values in the segment circle for optimum airflow characteristics.

R Table 203A. Data Sheet for Establishing Assembly
R Positions for Nozzle Segments
R

R 1. Assign three-vane nozzle segment position numbers by the
R effective flow area (AE) identified on the segments. As-
R sign Position No. 2 to segment with highest AE. Continue
R assignment of position numbers to remaining segments in or-
R der by highest AE, assigning Position No. 14 to segment
R with lowest AE.

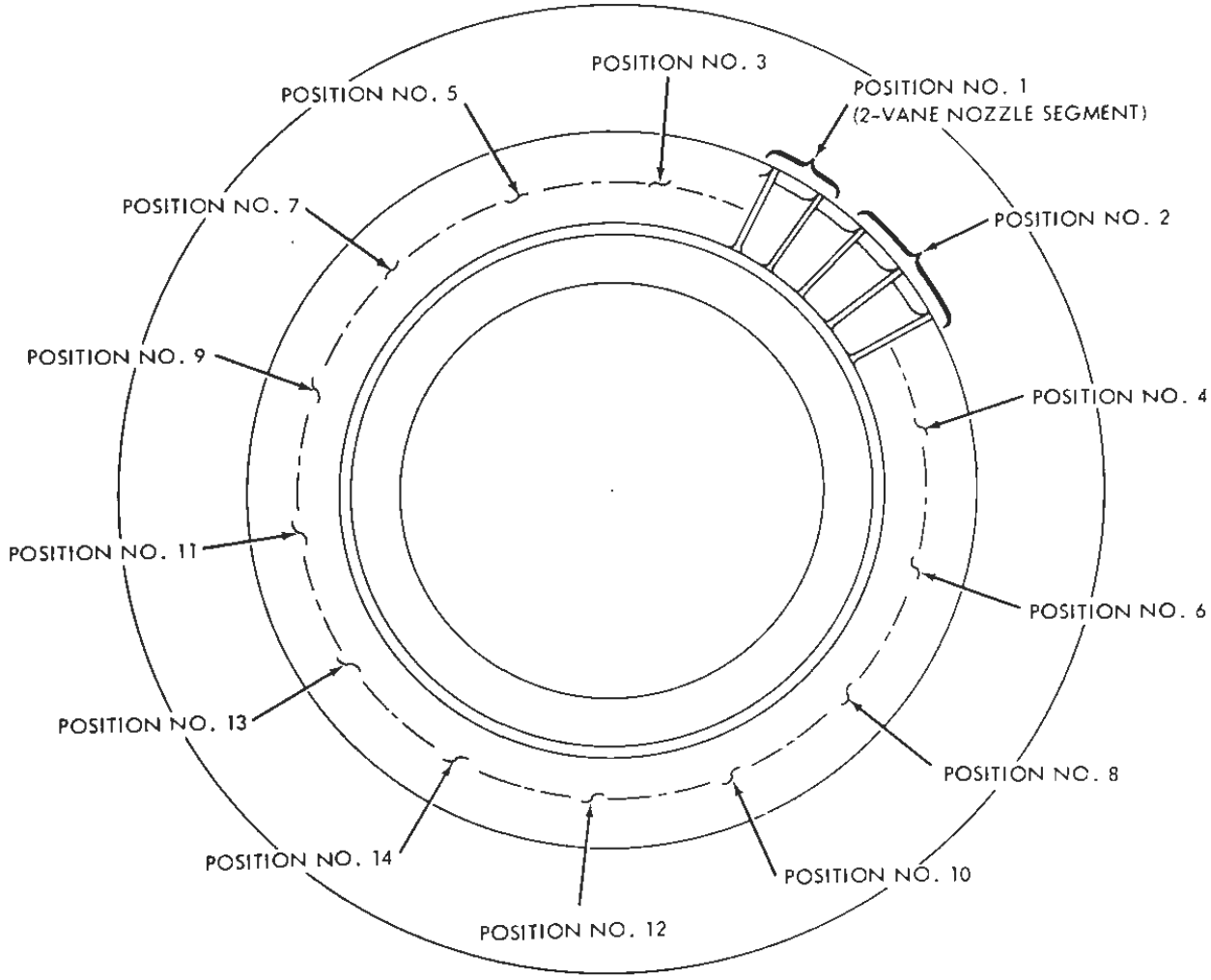
R 2. Index each nozzle segment with assigned position number.
R Record effective flow area (AE) and part number of segment
R on the following list.

R 3. Retain completed data sheet with engine log book.

R

R Position No. (See Figure 202A)	Effective Flow Area (AE) (square in.)	Nozzle Segment Part Number
R 1		3071767-2
R 2		
R 3		
R 4		
R 5		
R 6		
R 7		
R 8		
R 9		
R 10		
R 11		
R 12		
R 13		
R 14		

R



R Position Number Location for Installation
R of Nozzle Segments
R Figure 202A

1. B. (1) (f) Position upper end nutplates of each retaining flange segment at offset in bolt hole pattern in outer flanges of nozzle segments. On units utilizing retaining flange segments with two threaded holes in each nutplate, the clockwise threaded hole of each nutplate will not be used.

(g) Position airseal support on nozzle segments with offset bolt hole matching location of two-vane nozzle segment bolt hole. Make certain tabs of nozzle segments are engaged in nozzle support groove.

(h) Coat threads of bolts used with key washers with high temperature compound (Fel-Pro C5-A) and install new key washers and bolts through assembled parts and into threaded holes of flange segments. Tighten bolts to torque of 40 inch-pounds. Bend tabs of key washers against flats of bolt heads.

(i) Install piston ring seal in outer groove in airseal support. If seal is comprised of two rings, slip plain ring in first, then install outer ring 180 degrees out of phase with plain ring and attach with self-locking device in seal.

(2) Remove nuts used to attach nozzle support to airseal ring and coat threads with high temperature compound (Fel-Pro C5-A), then attach assembled parts to high pressure compressor diffuser on engine with nuts and bolts. Tighten bolts to torque of 50 to 60 inch-pounds. Offset hole in diffuser bolt pattern is at the 12 o'clock position.

NOTE: Accomplishment of step (3) is required only if the front coupling removed from engine is not to be reinstalled, and a replacement front coupling is installed in its place. This procedure requires that the front coupling being replaced be marked for proper orientation as specified in step 1.A.(14). If no index marks were applied at removal, perform procedure of step (7) to establish index mark on front coupling to be replaced before proceeding.

1. B. (3) Perform the following procedure, when front coupling removed from engine is to be replaced, to ensure replacement part is acceptable.

(a) Clean curvic coupling teeth of replacement front coupling and 294145-1 gage with suede brush, then flush curvic coupling teeth with solvent, Stoddard (Federal Specification P-D-680, Type I).

(b) Place replacement front coupling on 294145-1 gage with forward end against gage. Loosen locking screws on gage and rotate curvic coupling of gage to allow full engagement of curvic coupling teeth on gage and front coupling.

(c) Using depth micrometer, measure and record dimension from top of shaft on 294145-1 gage to top of a curvic coupling tooth on aft face of front coupling. Mark tooth used for measurement using industrial marking ink (Violet, No. 127-1/2) or yellow china marker (No. 170T).

(d) Repeat step (c) three times to provide measurements at four locations separated by approximately 90 degrees, and mark teeth providing minimum and maximum dimensions.

(e) Remove replacement front coupling from gage.

(f) Clean curvic coupling teeth of damaged front coupling to be replaced and 294145-1 gage with suede brush, then flush curvic coupling teeth with solvent, Stoddard (Federal Specification P-D-680, Type I).

(g) Place damaged front coupling on 294145-1 gage with forward end against gage. Rotate curvic coupling of gage to allow full engagement of curvic coupling teeth on gage and front coupling.

1. B. (3) (h) Repeat step (c) to provide measurement on damaged front coupling at four locations separated by approximately 90 degrees.

(i) While holding front coupling firmly against gage, tighten locking screws on gage to torque of 25 inch-pounds.

(j) Repeat step (c) to provide measurements on damaged front coupling at four locations previously marked to ensure no motion of parts occurred while tightening gage locking screws.

(k) If micrometer measurements of steps (h) and (j) are not the same, loosen gage locking screws and repeat steps (h) through (k) to ensure front coupling does not shift when locking screws are tightened.

NOTE: Dimensions recorded in steps (h) and (j) are only to ensure front coupling does not shift when locking screws are tightened. Discard dimensions recorded when step (k) is completed.

Do not loosen locking screws on gage after step (k) is completed.

(l) Using industrial marking ink (Violet, No. 127-1/2) or yellow china marker (No. 170T), mark shaft of gage corresponding to mark made on damaged front coupling splines at removal from engine.

(m) Remove damaged front coupling from gage.

(n) Clean curvic coupling teeth of replacement front coupling and gage with suede brush, then flush curvic coupling teeth with solvent, Stoddard (Federal Specification P-D-680, Type I).

(o) Place replacement front coupling on gage with forward end against gage. Select orientation of front coupling on gage splines which allows full engagement of curvic coupling teeth. Do not force.

1. B. (3) (p) Repeat step (c) at points identified in step (d) as providing minimum and maximum dimensions. Measurements shall match measurements initially recorded for step (c) within 0.003 inch. If measurements do not match as specified, front coupling is not satisfactory for installation. Select another replacement front coupling and repeat steps (a) through (p).

(q) Using industrial marking ink (Violet, No. 127-1/2) or yellow china marker (No. 170T) transfer mark on shaft of gage (step (l)) to splines of selected replacement front coupling.

(r) Remove replacement front coupling from gage.

(4) Clean curvic coupling teeth on high pressure impeller (which mate with front coupling) and on forward end of front coupling with suede brush, then flush curvic coupling teeth with solvent, Stoddard (Federal Specification P-D-680, Type I).

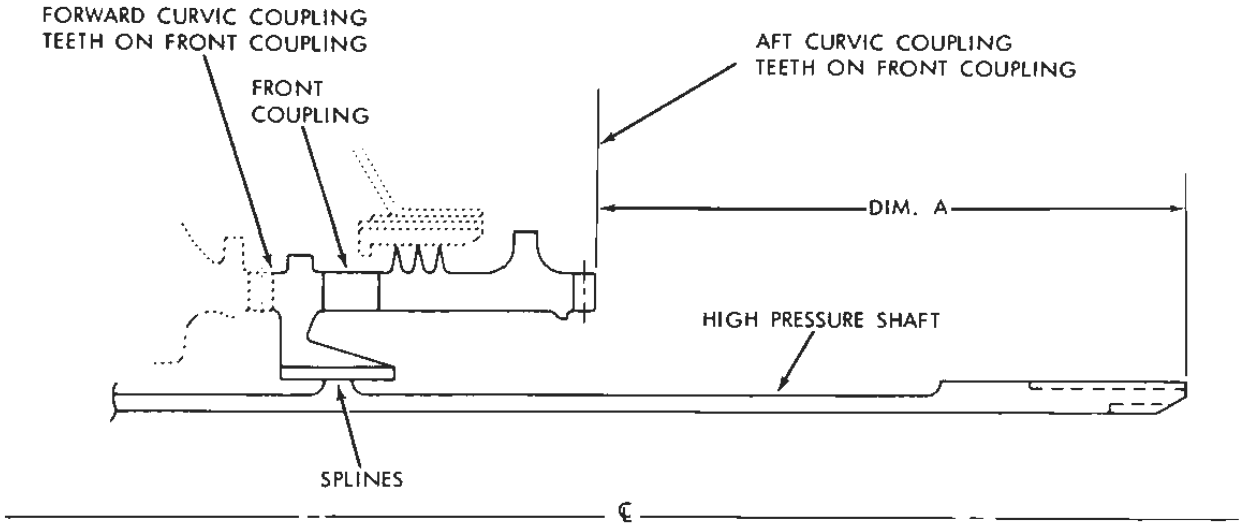
(5) Install front coupling on engine with index mark on front coupling splines aligned with mark on splines of high pressure shaft made at removal (step 1.A.(14)).

NOTE: Accomplishment of step (6) is required only if front coupling removed from engine is not serviceable and a replacement front coupling is being installed in its place.

(6) Verify relative positioning calculation of replacement front coupling (Dimension A, figure 203) as follows.

(a) Measure and record axial position of replacement front coupling.

(b) Dimension obtained shall agree with Dimension A measured in step 1.A.(15). If dimensions are not the same within 0.010 inch, curvic coupling teeth are not properly engaged. Repeat procedure.



F-48A-367

Positioning Front Coupling on High Pressure Shaft
Figure 203

NOTE: Accomplishment of step (7) is required only when front coupling was removed from engine without making index marks on splines (step 1.A.(14)) to show proper orientation of parts. This procedure is applicable only for front coupling removed from engine (step 1.A. (16)).

1. B. (7) If no relative position mark was applied to front coupling at removal from engine, establish and mark proper orientation of parts to ensure full engagement of curvic coupling teeth as follows.

(a) Clean curvic coupling teeth of high pressure impeller (which mate with front coupling) and on forward end of front coupling with suede brush, then flush curvic coupling teeth with solvent, Stoddard (Federal Specification P-D-680, Type I).

(b) Hold high pressure shaft and rotate front coupling in one-tooth increments of internal splines through full rotation of front coupling on high pressure shaft. Measure and record axial position (Dimension A, figure 203) at each position. Most forward position of front coupling (greatest Dimension A measurement) indicates correct orientation (curvic coupling teeth fully engaged).

(c) Engage front coupling in selected position.

(d) Apply relative position marks to front coupling and high pressure shaft splines using yellow china marker (No. 170T) or industrial marking ink (Violet, No. 127-1/2).

(8) Install seal ring, rotor assembly, seal ring, and aft coupling with components oriented as indexed at disassembly. If components to be installed have no indexing marks, install components with high point marks (V or I) on mating curvic couplings 180 degrees apart. Verify engagement by turning rotor assembly back and forth and noting that high pressure shaft follows rotor assembly. With curvic couplings properly engaged, hand load rotor assembly forward until round nut is installed. Coat threads of high pressure shaft and round nut with high temperature compound (Fel-Pro C5-A). Install round nut hand tight.

NOTE: Hand load the high pressure rotating group forward (with approximately 15 pounds of force) during all measurements.

1. B. (9) Measure and record Dimension YY (on work sheet of table 203) from Surface B on aft surface of aft coupling to Surface A on flange of plenum case using a parallel bar. (See figure 202.) Ensure measurement is taken from points marked during removal.

(10) Measure and record Dimension BB (on work sheet of table 203) (zero shaft stretch measurement) from Surface C on end of high pressure shaft to Surface A on aft flange of plenum case using a parallel bar. (See figure 202.) Ensure measurement is taken from same points marked during removal.

NOTE: It is permissible that the dimensional requirement of the following step be within 0.020 inch of measurement recorded in steps 1.A.(11) and (12) if components other than those removed at disassembly are installed.

(11) Compare Dimension YY (step (9)) with Dimension Y (step A.(11)) recorded at removal. Compare Dimension BB (step (10)) with Dimension B (step A.(12)) recorded at removal. Dimensions shall be the same within $\pm$0.004 inch. If dimensions are not as specified, curvic coupling teeth are not properly aligned. If required, disassemble components from high pressure shaft and repeat steps (4) through (9) to obtain correct curvic coupling teeth alignment.

WARNING: DO NOT STAND BEHIND, ABOVE, OR BELOW SHAFT STRETCH FIXTURE WHEN PRESSURE IS APPLIED TO FIXTURE IN THE FOLLOWING STEPS. A FAILURE OF HIGH PRESSURE SHAFT OR FIXTURE WOULD EXPEL FIXTURE AFT WITH CONSIDERABLE FORCE.

CAUTION: WHEN PERFORMING THE FOLLOWING PROCEDURE, MAKE CERTAIN FORCE SPECIFIED IS NOT EXCEEDED TO ENSURE SHAFT IS NOT OVERSTRETCHED. IF SPECIFIED STRETCH IS EXCEEDED, APPLY PRESSURE WITH SHAFT STRETCH FIXTURE (NOT TO EXCEED PRESSURE SPECIFIED FOR SHAFT STRETCH TOOL USED) SUFFICIENT TO LOOSEN ROUND NUT ON HIGH PRESSURE SHAFT, RELIEVE PRESSURE ON FIXTURE, AND REPEAT PROCEDURE. ENSURE PROPER SPECIAL TOOLING IS USED.

1. B. (12) Stretch shaft as follows using 293001-1 or 293001-3 fixture to obtain dimensional stretch of 0.0132 to 0.0143 inch.

(a) Ensure 292032-2 sleeve is installed on 293001-1 or 293001-3 fixture.

(b) Disassemble 293001-1 or 293001-3 fixture to separate threaded rod and wrench. Clean threads of fixture components and mating threads for fixture on engine component. Lubricate threads on threaded rod of fixture with a light coat of lubricating compound (Liqui-Moly, Grade NV, thread compound).

CAUTION: ENSURE ROD PORTION OF FIXTURE ENGAGES A MINIMUM OF FIVE AND ONE-FOURTH THREADS IN INTERNAL BORE OF HIGH PRESSURE SHAFT WHEN PERFORMING THE FOLLOWING STEP TO ENSURE PROPER INSTALLATION OF FIXTURE AND PREVENT DAMAGE TO SHAFT.

(c) Thread fixture rod portion of 293001-1 or 293001-3 fixture into internal threads of high pressure shaft until rod bottoms in shaft, counting turns of thread engagement. A minimum number of five and one-fourth turns ensures proper installation of rod.

(d) Ensure high pressure rotating group does not turn, then back fixture rod out one-fourth turn.

(e) Slide wrench portion of fixture forward over fixture rod to engage holes in round nut.

CAUTION: ENSURE WING NUT OF FIXTURE ENGAGES A MINIMUM OF FOUR THREADS WHEN PERFORMING THE FOLLOWING STEP TO ENSURE PROPER INSTALLATION OF FIXTURE.

1. B. (12) (f) Carefully assemble adapter and cylinder assembly of fixture over fixture rod. Secure assembly with wing nut on end of fixture rod while holding fixture forward against rotating group. Ensure wing nut engages a minimum number of four threads to ensure proper installation of fixture.

(g) Install wing nut to bottoming position.

(h) Use hand pressure to align cylinder assembly of fixture concentrically with fixture rod, then apply sufficient pressure with hydraulic pump of fixture to support cylinder in aligned position.

(i) Slowly continue to apply pressure with hydraulic pump of fixture until fixture pressure gage indicates 6100 psig.

(j) Turn fixture wrench clockwise using 3/8 x 8 inch dowel pin inserted in one of the fixture wrench insertion holes, to hand tighten round nut.

(k) Slowly relieve hydraulic pressure on fixture and remove fixture.

CAUTION: WHEN REQUIRED TO INCREASE HYDRAULIC PRESSURE ON FIXTURE AS SPECIFIED IN THE FOLLOWING STEP, DO NOT EXCEED 7450 PSIG ON FIXTURE PRESSURE GAGE.

NOTE: Take measurement at previously made markings.

(l) Measure high pressure shaft stretch to ensure high pressure shaft has been stretched 0.0132 to 0.0143 inch. If stretch is less than required, repeat step (c) through (k) with hydraulic pressure applied in step (i) increased 50 psig at each repetition of procedure until specified shaft stretch is obtained. Do not exceed hydraulic pressure of 7450 psig on fixture gage.

NOTE: Hand load the high pressure rotating group forward (with approximately 15 pounds of force) during all dimensional measurements.

1. B. (13) Measure and record Dimension XX (on work sheet of table 203) from Surface B on aft surface of aft coupling to Surface A on flange on plenum case using a parallel bar. (See figure 202.) Ensure measurement is taken from points marked during removal.

(14) Measure and record Dimension AA (on work sheet of table 203) from Surface C on end of high pressure shaft to Surface A on aft flange of plenum case using a parallel bar. (See figure 202.) Ensure measurement is taken from same points marked during removal.

(15) Compare Dimension XX (step (13)) with Dimension X (step 1.A.(7)) recorded at removal. Compare Dimension AA (step (14)) with Dimension A (step 1.A.(8)) recorded at removal. Dimensions shall be the same within +0.004 inch. If components other than those removed at disassemble are installed, dimensional requirements must be held within 0.020 inch of measurement recorded at removal.

CAUTION: IF TOOL OTHER THAN 293070-1 CRIMPER IS USED TO DEFLECT NUT FLANGE IN THE FOLLOWING STEP, HP SPOOL BEARINGS MAY BE DAMAGED.

R R (16) Lock position of round nut by deflecting flange (in area not previously crimped) of round nut into one of the indentations in aft coupling using 293070-1 crimper.

(17) Install duct-nozzle-low pressure turbine module in accordance with steps 1.B.(4) through 1.B.(16) only of 72-40-02, MAINTENANCE PRACTICES.

(18) Install N1 transducer installation (except for transducer access cover plate) in accordance with 77-10-03, MAINTENANCE PRACTICES.

(19) Install hardware securing thermocouple harness and N1 transducer leads with clamps, bolts, and nuts in accordance with 72-50-03, MAINTENANCE PRACTICES.

1. B. (20) Install rear turbine bearing oil tubes in accordance with 79-20-05, MAINTENANCE PRACTICES.

(21) Install N1 transducer access cover plate in accordance with 77-10-03, MAINTENANCE PRACTICES.

(22) Install oil tube assemblies which connect at bosses on right side and bottom of thrust and exhaust nozzle in accordance with 79-20-04, MAINTENANCE PRACTICES.

(23) Perform vibration check in accordance with 72-00-00, GENERAL - ADJUSTMENT/TEST, paragraph 12.

2. Inspection/Check

A. Inspect HP Turbine Rotor and Nozzle Assembly

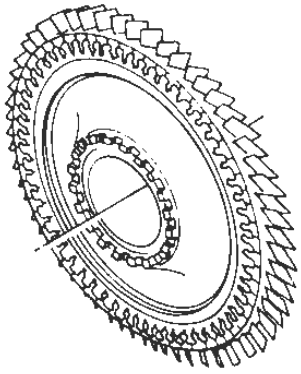
R CAUTION: USE CARE WHEN HANDLING COMPONENTS WITH
R CURVIC COUPLINGS AND KNIFE EDGE SEALS TO
R AVOID DAMAGE. REFER TO 70-00-00, 6, COM-
R PONENT HANDLING.

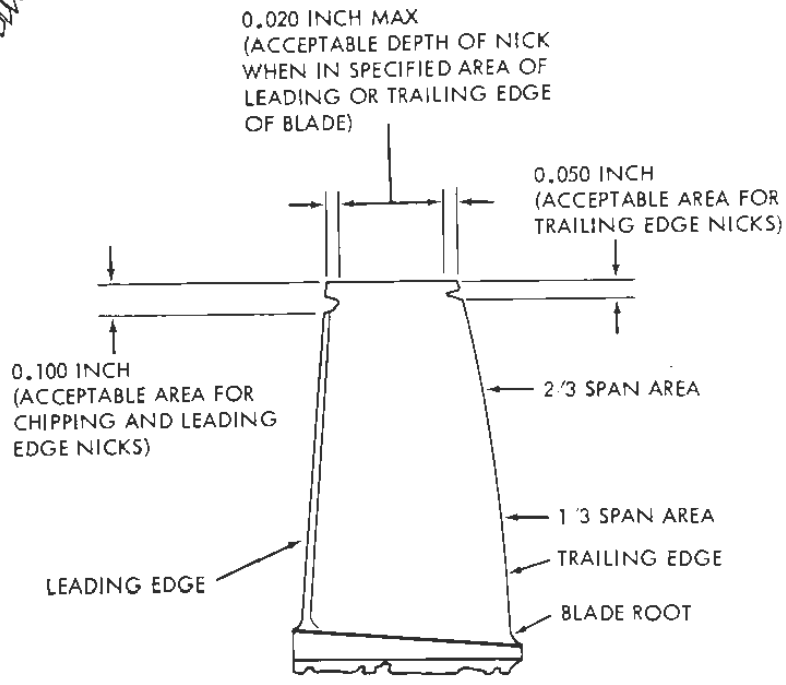
(1) Inspect rotor assembly for cracks, dents, warpage, distortion, and other damage. Light rub damage is acceptable. Check play in blades. Any axial movement exceeding 0.006 inch of the dovetail requires reriveting. Check blades for cracks, foreign object damage, and erosion as follows. (See figure 204).

(a) Visually inspect airfoil of each blade using a high intensity light. No cracks are permitted. Trailing edges are most susceptible to cracks. Particular attention should be given to the one-third and two-thirds span areas from the blade roots on the trailing edges.

R (b) Visually inspect airfoil of each blade for erosion
R and foreign object damage. Uniform erosion at
R leading edge which tends to slightly broaden or
R flatten leading edge is acceptable. Erosion at
R leading edge tip is acceptable if tip radius is no
R greater than 0.070 inch as measured with a radius
R gage. Bending or distortion of leading edge from
R normal leading edge contour is not acceptable.
R Chipping is expected near the blade tip due to tip
R rub and is acceptable if within 0.100 inch of blade tip. Nicks in blades which do not exceed a depth of 0.020 inch are acceptable if located within 0.100 inch of blade tip of leading edge, or if located within 0.050 inch of blade tip on trailing edge.

R





HP Turbine Blade Inspection
Figure 204

2. A. (2) Inspect seal rings for damage to sealing surfaces. Inspect for minimum free height of 0.234 inch.

(3) Inspect nozzle segments for cracks, dents, or evidence of burning. Cracks are not allowed in any portion of nozzle segments except trailing edges of vanes. A maximum of one crack per vane trailing edge is acceptable if crack length does not exceed 0.200 inch. Evidence of burning is not allowed on vane leading edges or on pressure (concave) side of vane airfoils of nozzle segments.

R (3a) Inspect coated surfaces on high pressure turbine nozzle
R for raised wringling or blistering. Raised wrinkling
R or blistering of coating material not acceptable.

(4) Inspect nozzle assembly for rub damage. Light rub damage is acceptable.

R (5) Inspect all curvic coupling teeth for
R handling/misassembly damage. Refer to 70-00-00, 6,
R Component Handling.

(6) Inspect knife blades on front coupling as follows.

(a) Uniform wear is acceptable if outside diameter of all blades is no less than 3.885 inches.

(b) Eccentric wear is acceptable if outside diameter of all blades is no less than 3.884 inches (at maximum eccentric wear) and if eccentric wear does not exceed 90 degrees of circumference. Remainder of wear shall be uniform and within limits of step (a).

(c) No burrs, cracks, or material buildup is acceptable on knife blade.

(7) Inspect abradable seal diameters mating with knife-edge seals for damage to contact path, both axially and on circumference. Slight chips and nicks in the seal edges are acceptable. Cracks that do not extend beyond the first knife-edge seal groove are acceptable. Flaking and chipping that do not extend beyond all knife-edge seal grooves are acceptable. Eccentric grooved pattern in abradable material seal area are acceptable but groove depth shall not exceed 0.030 inch. Refer to 70-00-00, GENERAL - STANDARD PRACTICES for general requirements.

2. A. (8) Inspect clearance on knife edge seal blades on aft coupling as follows.

CAUTION: USE CARE WHEN HANDLING COMPONENTS WITH CURVIC COUPLINGS AND KNIFE EDGE SEALS TO AVOID DAMAGE. REFER TO 70-00-00, 6, COMPONENT HANDLING.

(a) Measure and record outside diameter of large diameter knife edge seal blades on aft coupling.

(b) Measure and record inside diameter of abradable seal on interstage transition duct (72-50-05) which mates with large diameter knife edge seal blades on aft coupling. Measure abradable material at unworn area approximately 0.10 inch aft of leading edge of abradable material.

(c) Subtract dimension recorded in step (a) from dimension recorded in step (b). Difference (knife edge seal blade clearance) shall be 0.022 inch maximum.

NOTE: If clearance value determined in step (c) is not as specified, replace part or parts as required to obtain specified clearance. Manufactured (blue print) dimension for knife edge seal blades and abradable seal are as follows:

	Manufactured (Blue Print) Diameter (inches)
Large diameter knife edge seal blades	4.548 to 4.551
Abradable seal	4.557 to 4.560

(d) Measure and record outside diameter of small diameter knife edge seal blades on aft coupling.

(e) Measure and record inside diameter of abradable seal on shaft and seal assembly of low pressure turbine module (72-50-04) which mates with small diameter knife edge seal blades on aft coupling. Measure abradable material at unworn area approximately 0.10 inch aft of leading edge of abradable material.

2. A. (8) (f) Subtract dimension recorded in step (d) from dimension recorded in step (e). Difference (knife edge seal blade clearance) shall be 0.022 inch maximum.

NOTE: If clearance value determined in step (f) is not as specified, replace part or parts to obtain specified clearance. Manufactured (blue print) dimensions for knife edge seal blades and abradable seal are as follows:

	Manufactured (Blue Print) (Diameter (inches)
Small diameter knife edge seal blades	3.108 to 3.111
Abradable seal	3.117 to 3.120

(9) Check nuts on diffuser for security, stripped, or damaged threads. Some radial movement is acceptable. Stripped or damaged threads are not acceptable.

R (10) Inspect round nut for cracks as follows.

R (a) Visually inspect flange on nut for cracks (caused R by crimping operation). Cracks which are perpen- R dicular to threads are acceptable if crack length R does not extend full length of flange.

R (b) Visually inspect for cracks and distortion in body R of nut and for fretting of nut threads. Cracks, R distortion in body of nut or thread damage not R acceptable.

R (c) Perform fluorescent penetrant inspection in ac- R cordance with MIL-I-6866. Cracks not acceptable R except in nut flange.

(11) Replace items that do not meet inspection requirements of step (1) through (10) or that are damaged beyond repair limits of 4, Approved Repairs.

R

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Figure 205

3. Cleaning/Painting

A. Clean Parts

Clean parts as specified in Table 204 in accordance with cleaning methods provided in 72-00-00, GENERAL - CLEANING/PAINTING.

Table 204. Cleaning Methods

Figure No.	Item No.	Nomenclature	Cleaning Methods 1	2	3	4	5	6	7	8	9	10	11	12
All standard		metallic hardware	X	X										
201	5	Round Nut	X	X							X			
	10	Seal Rotor		X							X			
	15	Seal Ring		X							X			
	20	HP Turbine Rotor Assy		X								X		
	30	Seal Ring	X	X							X			
	35	Seal Rotor	X	X							X			
	40	Piston Ring Seal	X	X							X			
	65 through 145	HP Turbine Nozzle Assy		X							X			

4. Approved Repairs

Table 205. Special Tools, Fixtures and Equipment

Item No.	Nomenclature	Use	Source/ Part No.
NOTE: Equivalent substitutes may be used for listed items.			
1.	*Riveting Fixture	Supports HP turbine rotor assembly for riveting (used with 294119-1 riveting machine as alternate equipment for 293181-1 riveting fixture).	289923-1
2.	*Nut	Used for balancing HP tub-bine rotor assembly.	290565-1
3.	*Tie Bolt	Used for balancing HP turbine rotor assembly.	290566-4
4.	*Coupling	Used for balancing HP turbine rotor assembly.	290701-1
5.	*Coupling	Used for balancing HP turbine rotor assembly.	290702-1
6.	*Rivet Set	Used to swage rivets (component of 293181-1).	292533-1
7.	Rivet Set	Used to swage rivets (components of 293181-1).	292533-2
8.	*Turbine Wheel Riveting Fixture	Used for aligning blades and installing rivets on HP Turbine rotor assembly.	293181-1
9.	Nutplate Wrench Set	Used to install nuts on diffuser.	293328-1
10.	*Squeeze Type Riveting Machine	Installs rivets on HP tur-bine rotor (used with 289923-1 riveting fixture as alternate equipment for 293181-1).	294119-1

*For use only at a Garrett Approved Repair Center.

Table 205. Special Tools, Fixtures and Equipment (Cont)

Item No.	Nomenclature	Use	Source/ Part No.
NOTE: Equivalent substitutes may be used for listed items.			
11.	*Scale (Capable of measuring to an accuracy of ±10 milligram)	Used to weigh blades on HP turbine rotor assembly	Commercially Available
12.	*Standard Balancing Machine	Used for balancing rotating assemblies.	Gisholt, Model 13S
13.	*Vibro-Peen	Used for etching identification marking on replacement blades.	Commercially Available
14.	*Force gage (0 to 1000 lb, compression type)	Used to measure load when checking reriveted HP turbine blades.	Model U Ajax, with J4C fitting, WC Dillon Co, Inc, 14620 Keswick St, Van Nuys, CA 91407

*For use only at a Garrett Approved Repair Center.

Table 206. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed item.	
Penetrating oil (WD-40)	WD-40 Co, 1061 Cudahy Place, San Diego, CA 92110

CAUTION: REPAIR BY BLADE REPLACEMENT AS SPECIFIED IN PARAGRAPHS 4.A. THROUGH 4.D. SHALL BE PERFORMED ONLY BY A GARRETT APPROVED REPAIR CENTER.

NOTE: Replacement of rivets requires blade removal.

4. A. Rerivet Blades in HP Turbine Rotor Assembly

(1) Apply penetrating oil (WD-40) liberally to fir tree areas of blades to be removed and to both heads of rivets securing blades to be removed. Allow penetrating oil to soak overnight.

CAUTION: SUPPORT TURBINE ROTOR ASSEMBLY IN SUCH A MANNER THAT CURVICS OF ROTOR DO NOT CONTACT A SURFACE.

NOTE: If more than one blade is to be removed, note position where individual blades are located. Mark blades to their removed positions using yellow china marker (No. 170T) or industrial marking ink (Violet, No. 127-1/2).

(2) Gently drive blade at base using a common 3/16 inch diameter aluminum or nylon tipped drift toward direction of flared rivet end. Use caution not to damage blade airfoil or rotor.

(3) Install blade in its respective position. Inspect rivet-head mating surfaces (Surfaces A and B, figure 206) on blade and disc. Surfaces shall meet requirements of Figure 206.

NOTE: Ensure that rivet head is seated in the rotor and blade rivet bore radii.

(4) Select largest diameter rivet (from applicable part numbers for rivet) which can be installed using strong hand pressure. Seat rivet head by tapping lightly with flat punch.

NOTE: When available, 289923-1 riveting fixture and 294119-1 riveting machine may be used for rivet installation in lieu of 293181-1 riveting fixture. When using alternate equipment, install rivets by method specified in 72-50-04, 4, Approved Repairs.

4. A. (5) Run down bucking head portion of 293181-1 fixture using thumb screw action.

(6) Install rotor with blade(s) and rivet(s) on 293181-1 fixture with trailing edge of blade(s) up (rivet head down).

(7) Rotate rotor with blade(s) and rivet(s) as necessary on 293181-1 fixture, centering subject rivet over bucking head portion of fixture.

(8) Secure rotor with moderate hand pressure using plate and nut portion of fixture.

NOTE: Ensure that bucking head does not contact rotor and blade rivet bore radii.

(9) Run up bucking head of 293181-1 fixture using the thumbscrew action to contact center of rivet head, ensuring that base of bucking head mates flush with rotor and blade, adjust bucking head as necessary.

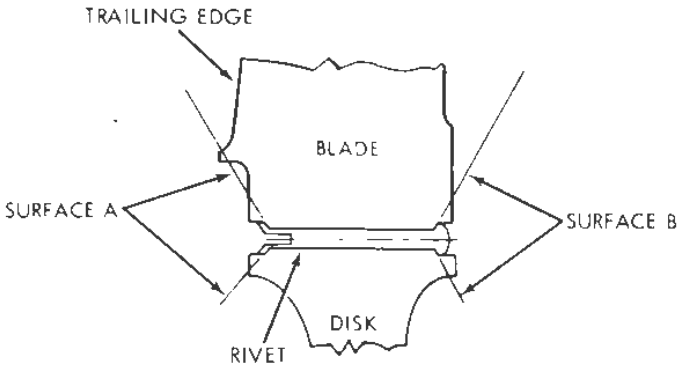
NOTE: Steps (5) and (9) need not be repeated after initial adjustment of bucking head during a rerivet procedure of the same turbine rotor assembly.

(10) Ensure that bucking head does not contact rotor and blade rivet bore radii. Swage rivet using 292533-1 rivet set, then follow by 292533-2 rivet set. Coat swaging tool or hollow shank of rivet with anhydrous lanolin prior to swaging rivet.

(11) Inspect each newly installed rivet in accordance with Figure 206. Verify blade retention load requirement (figure 206) of each newly installed rivet as follows.

(a) Fabricate a brass rod from one-half inch diameter stock as specified on Figure 207.

(b) Thread fabricated brass rod into lower threaded hole on force gage (Model U Ajax) and install pressure button fitting (J4C) in top of force gage deflection beam at threaded hole.

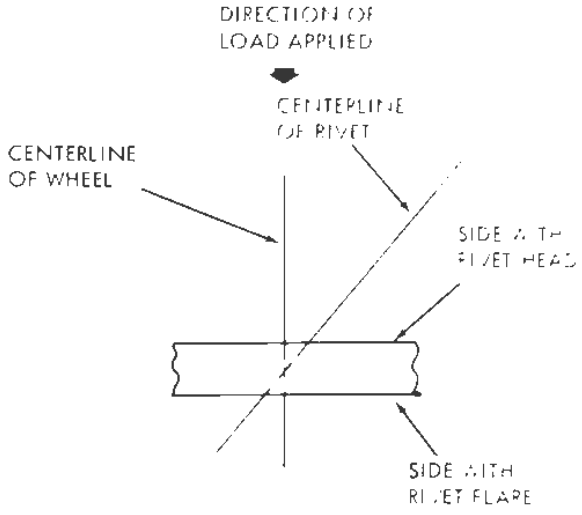


INSPECT SURFACES A AND B WHICH WILL BE IN CONTACT WITH RIVET HEADS AND FLARES. MATERIAL CUTS OR MARRING ON THESE SURFACES ON EITHER DISK OR BLADE IS NOT ACCEPTABLE.

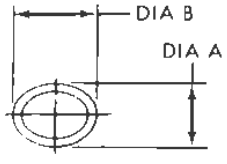
RINGED RIVET HEADS RESULTING FROM MISMATCH BETWEEN SPHERICAL RIVET HEAD AND SUPPORT ARE NOT ACCEPTABLE IF DEEPER THAN 0.005 INCH.

RIVET FLARE SHALL BE FREE FROM CRACKS UNDER VISUAL INSPECTION.

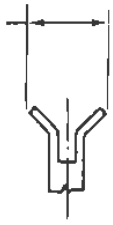
FLATTENED RIVET HEADS ARE ACCEPTABLE PROVIDED THE FLAT IS WITHIN THE CONFINES OF THE SPHERICAL RADIUS OF THE RIVET HEAD.

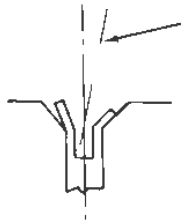


VERIFY BLADE RETENTION LOAD. WITH DISC SUPPORTED, APPLIED LOAD SHALL BE IMPOSED AS INDICATED. BLADE SHALL BE CAPABLE OF MEETING 300 POUND MINIMUM RETENTION LOAD.



THE OUTSIDE DIAMETER OF THE RIVET FLARE SHALL BE 0.090 INCH MINIMUM.



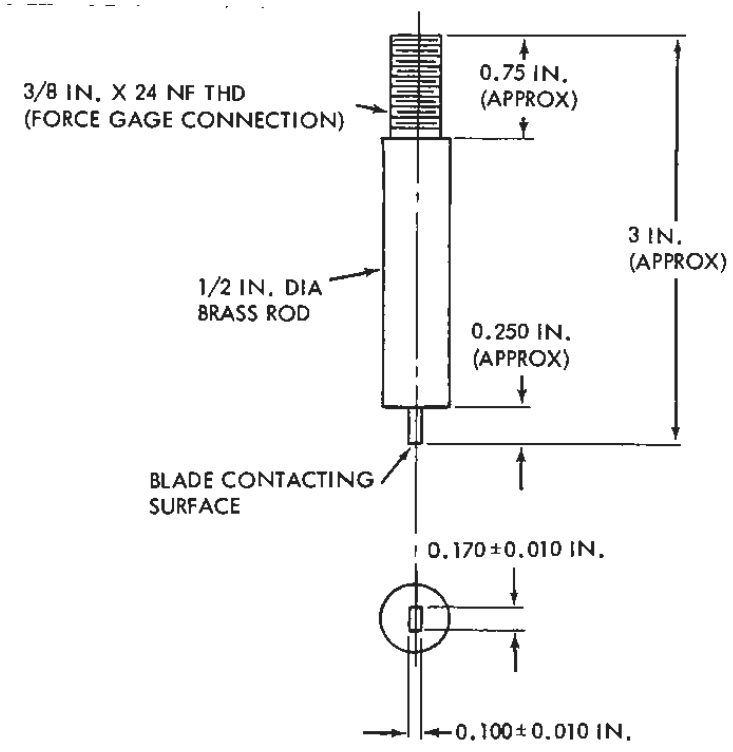


MALFORMED FLARES WITH MISALIGNMENT AS DETERMINED BY VISUAL INSPECTION ARE NOT PERMITTED.

RIVET FLARE DIAMETERS A AND B SHALL BE WITHIN 0.015 INCH AND DIAMETER A SHALL NOT BE LESS THAN MINIMUM ALLOWABLE OUTSIDE DIAMETER.

F-48A-185R1

HP Turbine Rotor Assembly
Figure 206

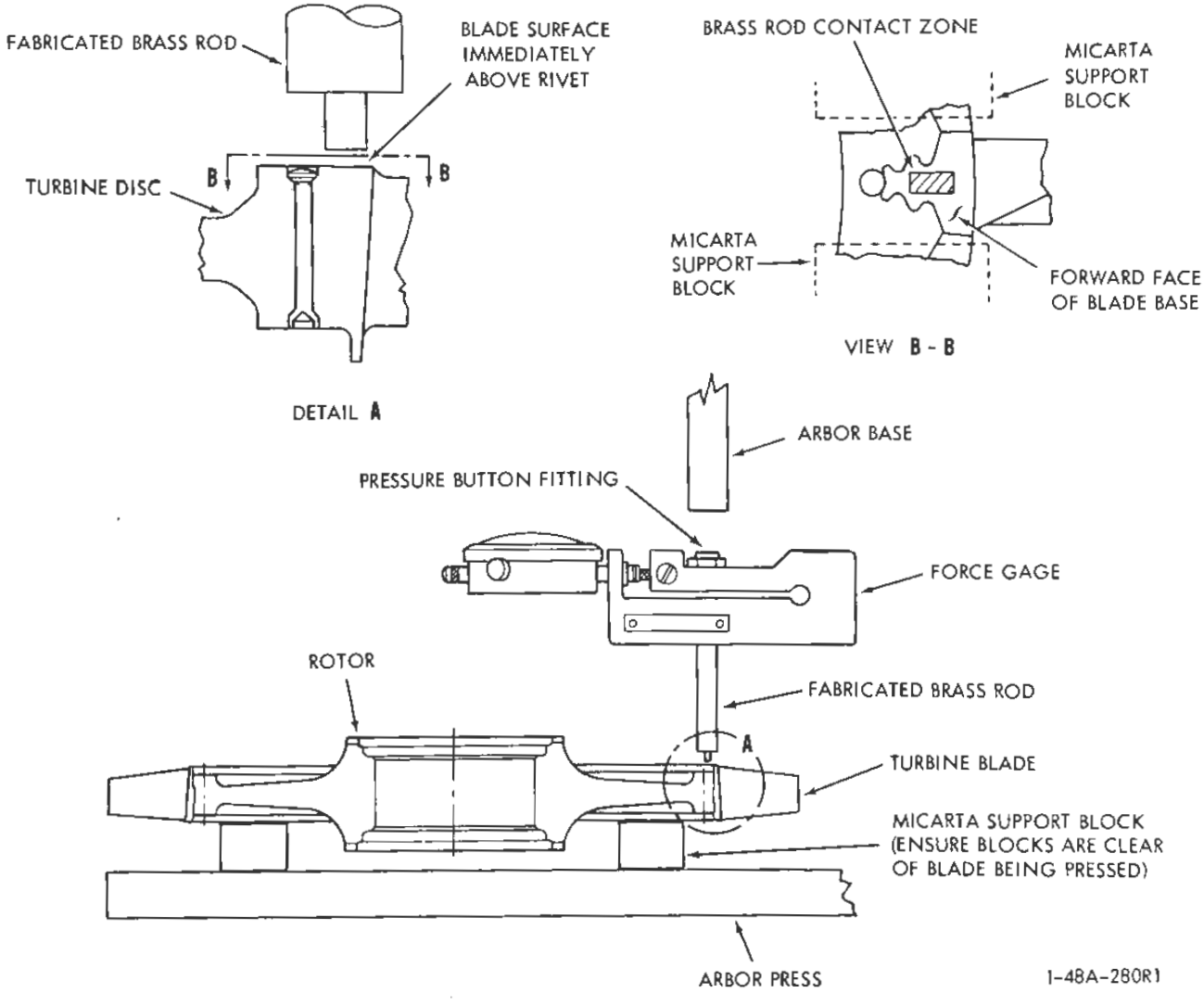


Brass Rod Fabrication
Figure 207

4. A. (11) (c) Position HP rotor assembly on arbor press with forward face up and aft face supported with micarta blocks at edge of rotor assembly disc. Ensure curvic couplings of rotor assembly are protected and do not contact any surface.

(d) Position blade-contacting surface of brass rod on base of newly riveted blade, just above rivet so blade-contacting surface rests entirely on blade base and not on disc. Ensure micarta support blocks are clear of blade. See Figure 208.

(e) With arbor press, momentarily apply force of 300 pounds to pressure button fitting of force gage as indicated on force gage dial. Reriveting is required if there is any axial movement of blade.



HP Turbine Rotor Assembly Blade Retention Check Setup
Figure 208

4. A. (12) At each blade subjected to load retention requirement, inspect blades for axial looseness manually and inspect rivets in accordance with Figure 206. Reriveting is required for any blade with any axial looseness or any rivet not meeting the requirements of Figure 206.

(13) Inspect turbine rotor and blades for nicks, dents, or scratches. None are permitted.

(14) Make entry in permanent engine records (on rotor assembly life limited part log) noting engine operating time and repair accomplished. If blades were replaced in accordance with paragraph 4.B, C, or D, enter number of replaced blades. If repair was accomplished in accordance with paragraph 4.C or D, note that rotor assembly balancing was accomplished.

NOTE: Repair of rotor assembly by blade replacement shall be accomplished by the following applicable method, depending on previous repairs (as noted in permanent engine records) and extent of repair to be accomplished.

Installation of replacement blades when accumulative total (after repair) of replacement blades will not exceed 30 and will not exceed ten since last balancing of rotor assembly - refer to paragraph 4.B.

Installation of replacement blades when accumulative total of replacement blades will not exceed 30 and accumulative total of replacement blades is 11 to 20 since last balancing of rotor assembly - refer to paragraph 4.C.

Installation of replacement blades when total number of blades to be replaced at this repair exceeds 20 or total number of blades to be replaced plus number of replacement blades already installed exceeds 30 - refer to paragraph 4.D.

B. Repair HP Turbine Rotor Assembly by Installing One to Ten Replacement Blades

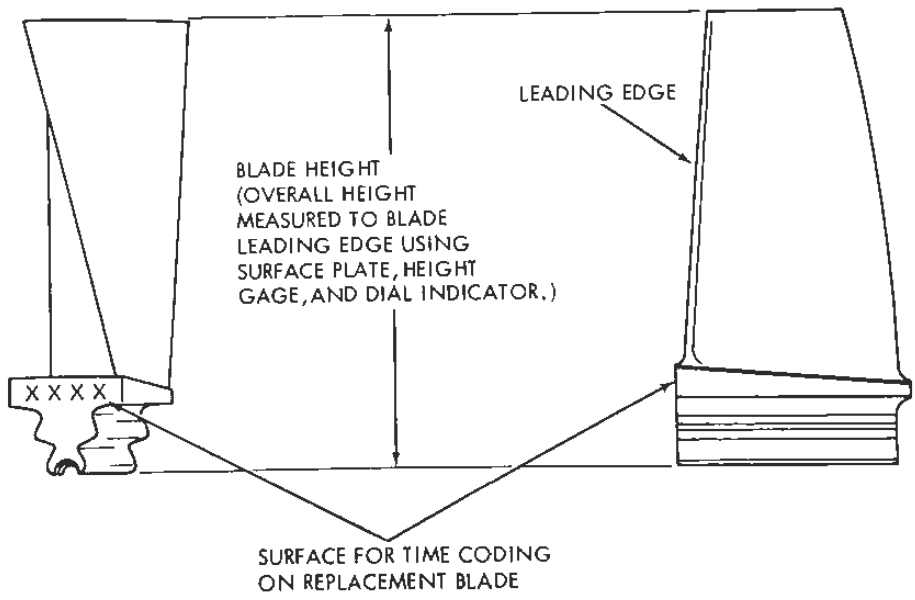
CAUTION: ANY USED BLADE REMOVED FROM A ROTOR ASSEMBLY SHALL NOT BE REINSTALLED ON ANOTHER ROTOR ASSEMBLY.

(1) Remove rivets and blades to be replaced in accordance with step A.(1).

(2) Weigh and measure height of blades to be replaced and respective replacement blades. Use surface plate with

height gage and dial indicator to determine blade height. (See figure 209.)

4. B. (3) Length of each new blade shall be within +0.004, -0.010 inch of respective removed blade. Weight of each new blade shall be within ±10 milligrams of respective removed blade. If blade being replaced is damaged to the extent that length and weight measurements are substantially affected, weigh blade 180 degrees from blade being replaced to establish weight requirement and measure length of adjacent blades to blade being replaced to establish length requirement. Grind outer tip of new blade airfoil as necessary to match length and weight requirement.



HP Turbine Rotor Assembly Blade Measurement Check
Figure 209

NOTE: Time coding of individual replacement blades as specified in step (4) is optional. When time coding of individual replacement blades is not used, all blades are considered to have same number of operating hours, as counted from time of last complete blade replacement noted in engine log book (on rotor assembly life limited part log).

4. B. (4) Identify replacement blades as follows (optional).

(a) Use a vibra-peen (commercially available tool) to mark replacement blade(s) at the forward base ensuring that etching is away from edges and above blade securing grooves. (See figure 209.)

(b) Mark replacement blades with letter A followed by time code symbol representing total operating hours accumulated by rotor assembly disc as determined from permanent engine records. Time codes are as specified in Table 207.

(c) For example, time code to be marked on a replacement blade installed on a rotor assembly having accumulated 675 operating hours would be A7.

(5) Install and inspect blades and rivets in accordance with steps 4.A.(3) through (14).

NOTE: Replace entire rotor assembly if tooling for the following repair is not available.

C. Repair HP Turbine Rotor Assembly by installing 11 to 20 Replacement Blades

CAUTION: ANY USED BLADE REMOVED FROM A ROTOR ASSEMBLY SHALL NOT BE REINSTALLED ON ANOTHER ROTOR ASSEMBLY.

(1) Remove, install, and inspect blades and rivets in accordance with paragraph 4.B.

Table 207. Blade Time Codes for HP Turbine Rotor Assembly

Time Code Symbol	Rotor Assembly Disc Operating Time (Hours)	Time Code Symbol	Rotor Assembly Disc Operating Time (Hours)
(No time code symbol)	0 to 50	26	2551 to 2650
		27	2651 to 2750
1	51 to 150	28	2751 to 2850
2	151 to 250	29	2851 to 2950
3	251 to 350	30	2951 to 3050
4	351 to 450	31	3051 to 3150
5	451 to 550	32	3151 to 3250
6	551 to 650	33	3251 to 3350
7	651 to 750	34	3351 to 3450
8	751 to 850	35	3451 to 3550
9	851 to 950	36	3551 to 3650
10	951 to 1050	37	3651 to 3750
11	1051 to 1150	38	3751 to 3850
12	1151 to 1250	39	3851 to 3950
13	1251 to 1350	40	3951 to 4050
14	1351 to 1450	41	4051 to 4150
15	1451 to 1550	42	4151 to 4250
16	1551 to 1650	43	4251 to 4350
17	1651 to 1750	44	4351 to 4450
18	1751 to 1850	45	4451 to 4550
19	1851 to 1950	46	4551 to 4650
20	1951 to 2050	47	4651 to 4750
21	2051 to 2150	48	4751 to 4850
22	2151 to 2250	49	4851 to 4950
23	2251 to 2350	50	4951 to 5050
24	2351 to 2450	51	5051 to 5150
25	2451 to 2550	52	5151 to 5250

CAUTION: PROPER HANDLING OF CURVIC COUPLINGS ON ROTOR ASSEMBLY DISC IS MANDATORY TO PREVENT DAMAGE WHICH MAY REQUIRE REPLACEMENT OF PART. ENSURE SPECIFIED COUPLINGS ARE USED IN THE FOLLOWING PROCEDURE TO MATE WITH ROTOR ASSEMBLY CURVIC COUPLINGS. MATING ANY COUPLING WITH CONCAVE TEETH TO CONCAVE TEETH ON ROTOR ASSEMBLY WILL DAMAGE PART.

4. C. (2) Install 290702-1 and 290701-1 coupling on HP turbine rotor assembly curvic coupling. Secure assembled components with 290566-4 tie bolt and 290565-1 nut. Install assembled components on a standard balancing machine (Gisholt, Model 13S).

(3) Dynamically balance rotor assembly on curvic couplings at a speed of 1575±100 rpm to an accuracy of 0.050 ounce-inch in Plane E, and to an accuracy of 0.050 ounce-inch in Plane F. (See figures 210 or 211, as applicable.) If unbalance is greater than 0.3 ounce-inch in either Plane E or F, reposition blades for optimum balance prior to any grinding on rotor. After meeting balance requirements for Planes E and F, balance rotor assembly to an accuracy of 0.030 ounce-inch using single plane centerline balancing method. Material may be removed for balancing from areas designated. All places where material is removed for balancing shall fair smoothly and leave no corners or edges sharper than 0.125 inch radius and have a surface finish of AA63 or better.

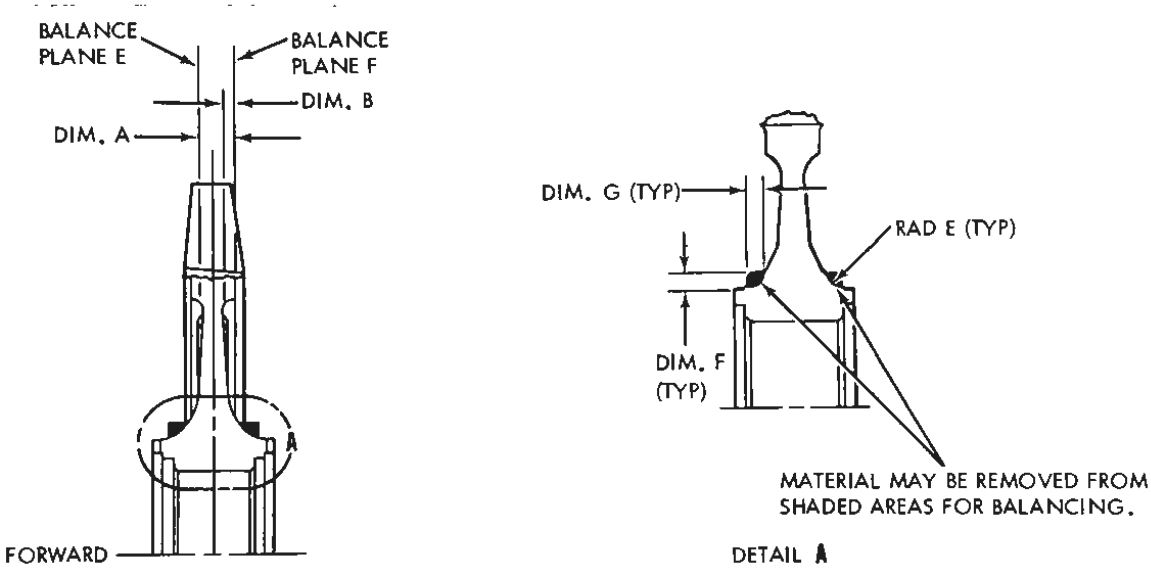
(4) Remove rotor assembly from standard balancing machine and 290702-1 and 290701-1 couplings, 290566-4 tie bolt, and 290565-1 nut.

NOTE: Replace entire rotor assembly if tooling for the following repair is not available.

D. Repair HP Turbine Rotor Assembly by Installing Up to 78 Blades

CAUTION: ANY USED BLADE REMOVED FROM A ROTOR ASSEMBLY SHALL NOT BE REINSTALLED ON ANOTHER ROTOR ASSEMBLY

(1) Remove all blades. (Refer to steps A.(1) and (2).) Part numbers of blades installed on rotor assembly determine part number of rotor assembly. Refer to latest revision of Service Bulletin 72-3026 for reidentification information. Last five digits of blade part number are electro-etched on blade base. For example, Blade, Part No. 3072455-4 is identified 2455-4.



A	B	E	F	G
0.502 IN. (REF)	0.148 IN. (REF)	0.25 IN. MAX	0.26 IN. MAX	0.22 IN. MAX

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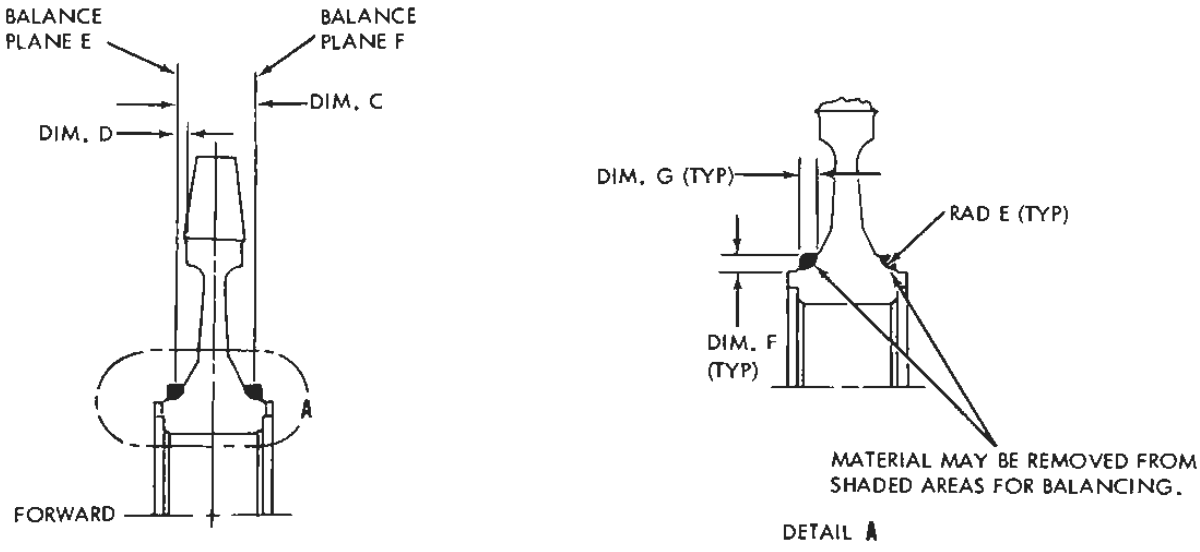
Balancing HP Turbine Rotor Assembly
Part No. 3070098-3
Figure 210



C	D	E	F	G
1.188 IN. (REF)	0.189 IN. (REF)	0.25 IN. MAX	0.26 IN. MAX	0.22 IN. MAX

I-48A-314

Balancing HP Turbine Rotor Assembly
(All Except Part No. 3070098-3)
Figure 211

4. D. (2) If any blades removed in the previous step are serviceable and are to be reinstalled (on same disc), set blades aside until reinstalled as specified in the following step. Discard all blades not to be reinstalled.

(3) Obtain number of new blades to be installed and line up blades on bench in ascending order of pan weight number ink-stamped on airfoil of blade.

(4) If any blades were set aside for reinstallation in step (2), intersperse these blades at regular intervals in lineup of blades to be installed.

NOTE: Pan weight numbers stamped on new blades are in grams (to nearest one-tenth gram). Weight numbers of new blades installed in opposing positions on rotor (180 degrees apart) shall be the same (except for new blades installed opposite previously used blades).

(5) Take first pair of blades from top of lineup of installation blades and install in opposing positions on disc (180 degrees apart).

(6) Working clockwise on disc, continue installing blade pairs (from top of installation blade lineup) in opposing positions around disc, adjacent to last installed blades. Mark blades to their respective positions and remove.

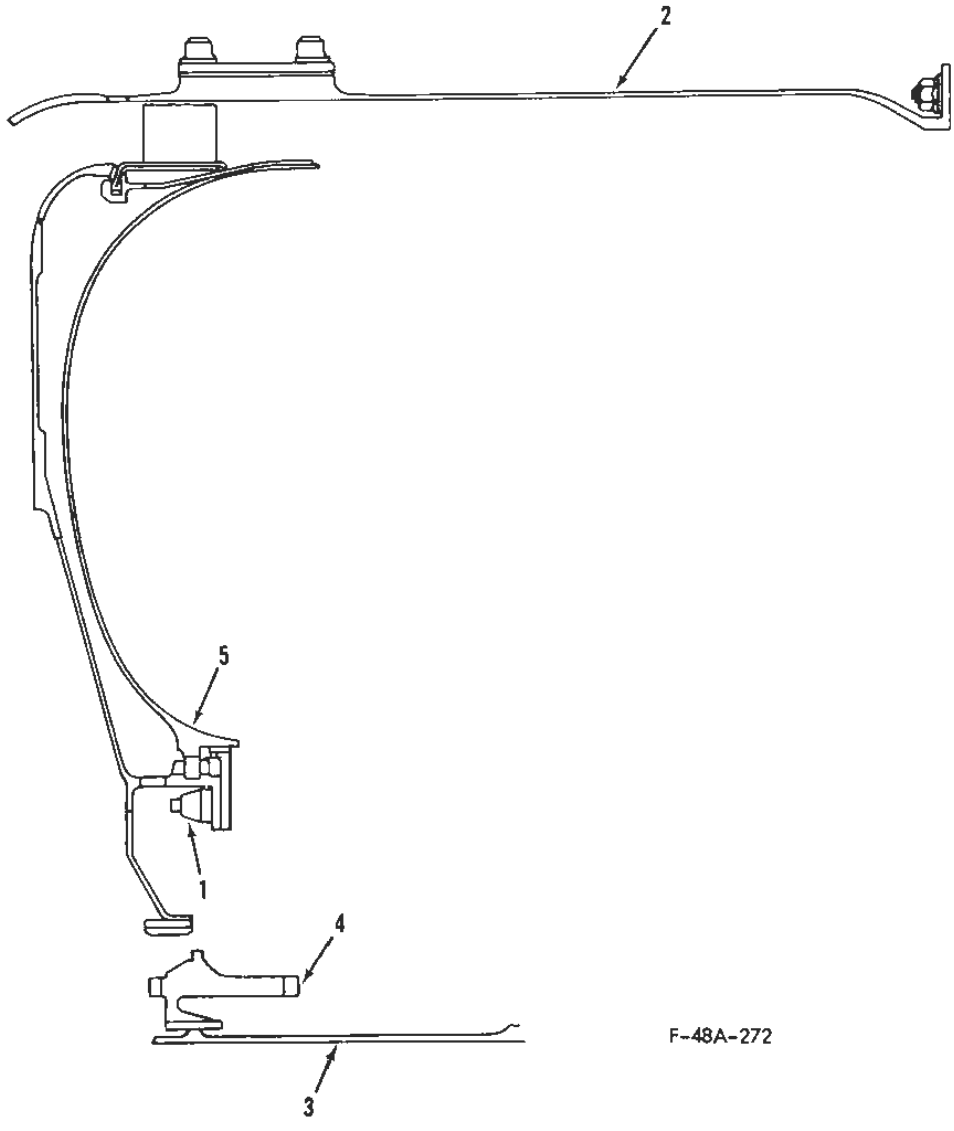
(7) Install and inspect blades and rivets in accordance with steps 4.A.(3) through (14).

(8) Dynamically balance rotor assembly in accordance with steps 4.C.(2) through 4.C.(4). Obtain optimum balance by relocating blades as required prior to grinding disc. Balancing by grinding shall not be attempted if imbalance exceeds 0.3 ounce-inch in either balance plant (figure 210).

E. Replace Damaged Nuts on Diffuser (See Figure 207)

(1) Remove damaged nut from diffuser using a punch.

(2) Install new nut on diffuser and secure using 293328-1 nutplate wrench set.



1. NUT
2. COMBUSTION CHAMBER PLENUM CASE
3. HP SHOULDERED SHAFT
4. HP SHAFT FRONT COUPLING
5. HP COMPRESSOR DIFFUSER

Replace Damaged Nuts on Diffuser
Figure 212

CHAPTER 72 - ACCESSORY DRIVES SECTION

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ACCESSORY DRIVES SECTION - DESCRIPTION AND OPERATION

1. General

The accessory drives section consists of the accessory drive gearbox assembly, the transfer shaft and tubes, the transfer gearbox assembly, and the tower shaft and housing, which are used as a mechanical power takeoff to drive the engine accessories. All of the components of the accessory drives section are contained in the accessory and transfer gearbox installation. The accessory drive and transfer gearboxes can be removed or installed on the engine as a module. If desired, either the accessory drive gearbox on the transfer gearbox may be removed and installed separately. The lube and scavenge oil pump and the fuel control assembly are mounted on the rear side of the accessory drive gearbox while the forward face of the gearbox provides three drives for airframe-furnished accessories.

The mechanical power available from the high pressure compressor and turbine shaft is transmitted by the use of bevel gears and the tower shaft coupled to the transfer gearbox. Through bevel gears in the transfer gearbox and the transfer shaft, mechanical power is transferred to the accessory drive gearbox for use in driving the accessories.

ACCESSORY AND TRANSFER GEARBOX INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Special Tools, Fixtures and Equipment

Item No.	Nomenclature	Use	Source Part No.
NOTE: Equivalent substitutes may be used for listed items.			
1.	Transfer Tube Mechanical Puller	Removes transfer tube.	291473-1
2.	Seal Pilot	Installs seal.	291474-1
3.	Seal Driver	Installs seal.	291475-1

Table 202. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Compound (Loctite 40 or 640 (MIL-R-46082, Type 2))	Loctite Corp, 705 N Mountain Rd, Newington, CT 06111
Grease (Aeroshell 17) (MIL-G-21164)	Shell Oil Co, 50 W 50th St, New York, NY 10020
Grease (Aeroshell 22) (MIL-G-81322)	Shell Oil Co, 50 W 50th St, New York, NY 10020
Grease (MIL-G-21164)	Commercially available
Grease (Mobil Grease No. 28) (MIL-G-81322)	Mobil Chemical Co, Chemical Coatings Div, 150 E 42nd St, New York NY 10017
Grease (Mobil Grease No. 29 (Molybdenum-Disulphide) (MIL-G-81827)	Mobil Chemcial Co, Chemical Coatings Div, 150 E 42nd St, New York NY 10017

Table 202. Materials and Compounds (Cont)

Material or Compound	Manufacturer
Primer (MIL-S-22473, Grade T)	Loctite Corp, 705 N Mountain Rd, Newington, CT 06111
Solvent (Shell 360)	Shell Oil Co, 50 W 50th St, New York, NY 10020
1,1,1-Trichloroethane (MIL-T-81533)	Dow Corning Corp, S Saginaw Rd, Midland, MI 48640

1. A. Removal and Installation of Complete Accessory and Transfer Gearbox Module

(1) Remove accessory and transfer gearbox module as follows. (See figure 201.)

(a) (Code A) Disconnect engine wiring harness from fuel control connectors and N2 transducer in accordance with 72-00-02, MAINTENANCE PRACTICES.

(b) Remove oil fittings from accessory drive gearbox and fuel tubes from fuel pump in accordance with 79-20-06, MAINTENANCE PRACTICES.

(c) Remove oil temperature regulator (fuel/oil cooler) oil and fuel tubes in accordance with 79-20-07, MAINTENANCE PRACTICES.

(d) Remove tubes from oil tank to oil pump and accessory drive gearbox in accordance with 79-10-01, MAINTENANCE PRACTICES.

(e) Remove fuel and P3 sensing lines installation in accordance with 73-10-02, MAINTENANCE PRACTICES.

(f) Remove oil pump and chip detector installation in accordance with 79-20-03, MAINTENANCE PRACTICES.

(g) Remove fuel system installation in accordance with 73-20-01, MAINTENANCE PRACTICES.

1. A. (1) (h) Remove tube assemblies and tee connected to oil jets on accessory drive and transfer gearboxes.

(i) Remove bolts and washers securing forward mounting struts to engine.

(j) Remove nuts and washers used on bolts securing tower shaft housing to transfer gearbox. (Bolts may not be removed until tower shaft housing is removed.)

(k) (Code A) Disconnect grounding cable from aircraft. Refer to Aircraft Maintenance Manual.

(l) (Code A) If installed, remove clamp securing grounding cable by removing nut, bolt, and washer securing clamp and grounding cable to oil filler tube, then remove clamp.

(m) (Codes B, C) Remove nuts, washers, and bolts securing module to engine; remove module. Remove shouldered shaft from tower shaft housing.

R (n) (Code A Pre SB72-3092) Remove nuts, washers, grounding cable, and bolts securing module to engine; remove module. Remove shouldered shaft from tower shaft housing.

R (o) (Code A Post SB72-3092) Remove nuts, washers,
R grounding cable, and bolts securing module. If
R required remove bushings. Remove shouldered shaft
R from tower shaft housing.

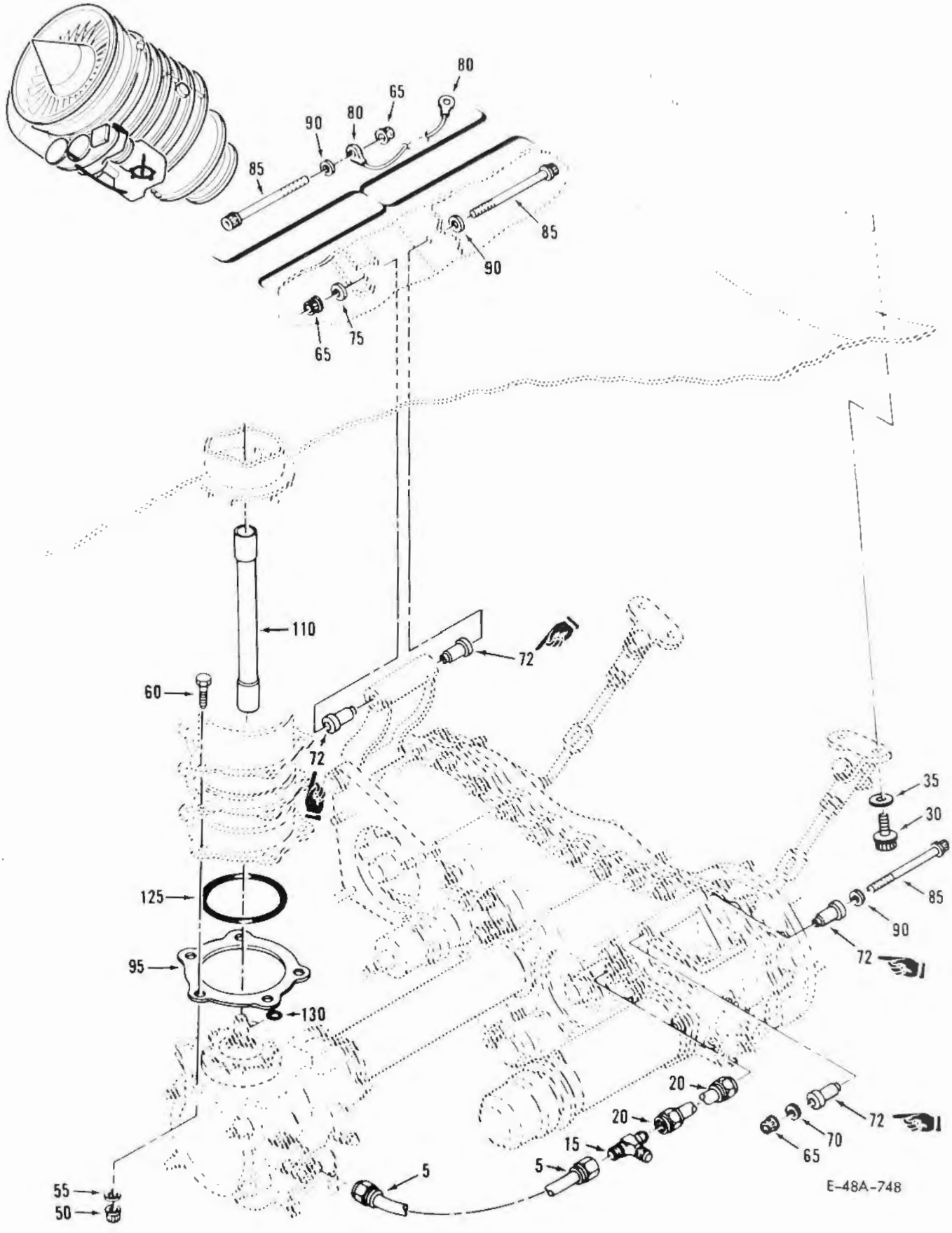
NOTE: Ensure that number and thickness of shims removed in the following step are recorded. A record of shim thickness is required for reassembly.

(p) Remove shims and packings from transfer gearbox upper face. Note number and thickness of shims removed.

(2) Install accessory and transfer gearbox module as follows. (See figure 201.)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(a) If transfer gearbox removed from engine has been replaced, determine shims required on transfer gearbox using removed transfer gearbox as follows:



Accessory Drive and Transfer Gearbox Module
Figure 201

1. A. (2) (a) 1) Measure dimension from top edge of oil jet hole at horizontal centerline of gearbox (see figure 203, bore where oil jet is installed) to mounting flange mating surface on transfer gearbox being replaced. Record as Dimension A.

2) Measure dimension from top edge of oil jet hole (see figure 203, bore where oil jet is installed) to mounting flange mating surface on transfer gearbox being installed. Record as Dimension B.

3) If Dimension B is less than Dimension A, add shim thickness equal to difference dimension to shims removed at Removal.

4) If Dimension B is greater than Dimension A, subtract shim thickness equal to difference dimension from shim removed at Removal.

(b) Install thickness of shims noted in step (1)(o) if original transfer gearbox and tower shaft housing are to be reinstalled. If replacement transfer gearbox is to be installed, install thickness of shims determined in step (a). If replacement tower shaft housing was installed, install thickness of shims determined in step 1.B.(2)(b). If both a replacement transfer gearbox and tower shaft housing are to be used, use thickness of shims determined in step 1.B.(2)(b) plus add or subtract, as applicable, difference of shims as determined in step (a).

KEY TO FIGURE 201

R 5. TUBE (IPC FIG. 62)
R 15. TEE
20. TUBE
30. BOLT
35. WASHER
50. NUT
55. WASHER
60. BOLT
65. NUT
70. WASHER
72. BUSHING (CODE A POST SB72-3092)
75. WASHER (CODES B, C)
80. GROUNDING CABLE (CODE A)
85. BOLT
90. WASHER
95. SHIM
110. SHOULDERED SHAFT
125. PACKING
130. PACKING

1. A. (2) (c) Install new packings on transfer gearbox input-shaft and flange mating with tower shaft housing.

(d) Loosen nut (105) securing housing support (figure 201, 72-60-02) to accessory drive gearbox. Install shouldered shaft in tower shaft housing. Position module on engine with mounting flanges aligned with engine support housing flanges, tower shaft housing, and shouldered shaft aligned with input shaft of module. (See figure 201.)

(e) (Codes B, C) Install bolts, washers, and nuts securing module to engine support housing.

R (f) (Code A Pre SB72-3092) Install bolts, washers, grounding cable, and nuts securing module to engine support housing.

R (f1) (Code A Post SB72-3092) Install bushings (if
R removed), bolts, washers, grounding cable, and
R nuts securing module to engine support housing.

R (g) (Codes B, C) (Code A Pre SB72-3092) Tighten nuts (65) to torque of 100 inch-pounds. Tighten nut (105) securing housing support (figure 201, 72-60-02) to accessory drive gearbox mount to torque of 60 inch-pounds.

R (g1) (Code A Post SB72-3092) Tighten nuts (65) to
R torque of 70 inch-pounds. Tiughten nut (105)
R securing housing support (figure 201, 72-60-02) to
R accessory drive gearbox mount to torque of 60
R inch-pounds.

(h) Secure transfer gearbox to tower shaft housing, seal, and retainer plate (figure 202) with bolts, nuts, and washers (figure 201). Tighten nuts (50) to torque of 100 inch-pounds.

(i) Position support struts on engine and secure with bolts and washers. Tighten bolts (30) to torque of 70 inch-pounds. If loosened, tighten nuts (35, 45, figure 202) against rod ends to torque of 100 inch-pounds.

(j) Install tube assemblies and tee to oil jets on accessory drive and transfer gearboxes. (See figure 201.)

1. A. (2) (k) (Code A) If removed at disassembly, install clamp on oil filler tube and secure grounding cable with clamp, nut, washer, and bolt. Tighten nut to torque of 40 inch-pounds. Attach free end of grounding cable to aircraft in accordance with Aircraft Maintenance Manual.

(l) Install fuel system installation in accordance with 73-20-01, MAINTENANCE PRACTICES.

(m) Install oil pump and chip detector installation in accordance with 79-20-03, MAINTENANCE PRACTICES.

(n) Install fuel and P3 sensing lines installation in accordance with 73-10-02, MAINTENANCE PRACTICES.

1. A. (2) (o) Install tubes from oil tank to oil pump and accessory drive gearbox in accordance with 79-10-01, MAINTENANCE PRACTICES.

(p) Install oil temperature regulator (fuel/oil cooler) oil and fuel tubes in accordance with 79-20-07, MAINTENANCE PRACTICES.

(q) Connect oil fittings to accessory drive gearbox and fuel tubes to fuel pump in accordance with 79-20-06, MAINTENANCE PRACTICES.

(r) (Code A) Connect engine wiring harness to fuel control, fuel control torque motor, and N2 transducer in accordance with 72-00-02, MAINTENANCE PRACTICES.

B. Removal and Installation of Tower Shaft Housing and Forward Mounting Struts

(1) Remove tower shaft housing and forward mounting struts as follows. (See figure 202.)

(a) Remove accessory and transfer gearbox module from engine. Refer to paragraph 1.A.

(b) Remove nuts, screws, and washers securing support bracket to strut assembly.

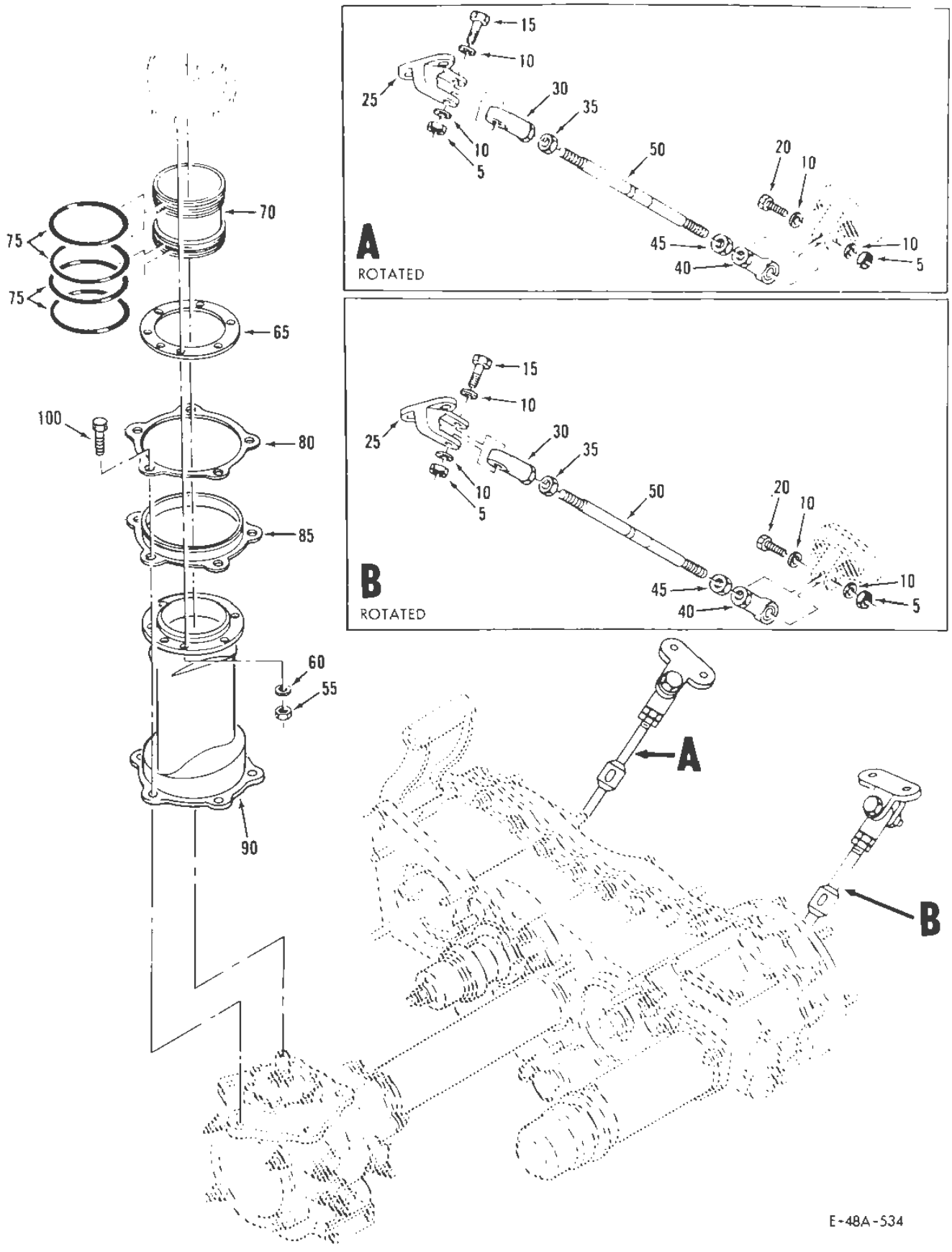
(c) Remove nuts, screws, and washers securing support strut assembly to accessory drive gearbox.

(d) If replacement of rod-end bearings is required, remove rod-end bearings and nuts.

(e) Remove bottom panel in accordance with 79-20-09, MAINTENANCE PRACTICES.

(f) Remove nuts and washers securing tower shaft housing to studs on engine and remove tower shaft housing, seal, retainer plate, and gasket. Remove bolts from lower flange of tower shaft housing.

(g) Remove oil transfer tube with 291473-1 puller. Remove four packings from oil transfer tube.



Tower Shaft Housing and Forward Mounting Struts
Figure 202

1. B. (2) Install tower shaft housing and forward mounting struts as follows. (See figure 202.)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(a) Install new packings on oil transfer tube and install oil transfer tube.

(b) If tower shaft housing removed from engine has been replaced, calculate shim thickness for shims installed on upper face of transfer gearbox (step 1.A.(2)(b)) as follows.

1) Measure over-all height of tower shaft housing being replaced. Record as Dimension A.

2) Measure over-all height of tower shaft housing to be installed. Record as Dimension B.

3) If Dimension B is less than Dimension A, add shim thickness equal to difference dimension to thickness of shims removed at Removal.

4) If Dimension B is greater than Dimension A, subtract shim thickness equal to difference dimension from thickness of shims removed at Removal.

(c) Position seal, retainer plate, and bolts on lower flange of tower shaft housing. Install gasket and tower shaft housing with assembled parts on engine. Attach clamp securing igniter leads to adjacent stud used to secure tower shaft housing. Secure tower shaft housing with washers and nuts. Tighten nuts (55) to torque of 50 inch-pounds.

KEY TO FIGURE 202

5. NUT (IPC FIG. 63)
10. WASHER
15. SCREW
20. SCREW
25. SUPPORT BRACKET
30. ROD-END BEARING
35. NUT
40. BEARING
45. NUT
50. SUPPORT STRUT
55. NUT
60. WASHER
65. GASKET
70. OIL TRANSFER TUBE
75. PACKING
80. RETAINER PLATE
85. SEAL
90. TOWER SHAFT HOUSING
100. BOLT

1. B. (2) (d) If removed, install nuts and rod-end bearings on support struts.

(e) Attach support struts to accessory drive gearbox and support bracket with screws, nuts, and washers. Tighten screws (15, 20) to torque of 35 inch-pounds.

(f) Tighten nuts (35, 45) securing rod-end bearings to torque of 100 inch-pounds.

(g) Install bottom panel in accordance with 79-20-09, MAINTENANCE PRACTICES.

(h) Install accessory and transfer gearbox module on engine. Refer to paragraph 1.A.

C. Removal and Installation of Splined Shaft and Gearbox Hardware

R (1) Remove splined shaft and gearbox hardware as follows. (See figure 203.)

(a) Remove accessory and transfer gearbox module from
R engine. Refer to paragraph 1.A.

(b) Remove tower shaft housing and forward mounting struts. Refer to paragraph 1.B.

(c) Remove nuts and washers securing oil jet, then remove oil jet and packings.

(d) Remove nut and retainer securing transfer shaft cover tube to accessory drive gearbox. Slide transfer shaft cover tube into transfer gearbox to clear accessory drive gearbox. Remove nuts and washers securing transfer gearbox cover, then remove cover and packing. Remove thrust washer and retaining ring. Withdraw splined shaft with packing from splines of accessory drive gearbox to separate gearboxes. Remove packing from shaft.

(e) Remove transfer shaft cover tube with packings and seal. Remove packings and seal. If seal was previously installed in transfer shaft cover tube with compound (Loctite 40 or 640 (MIL-R-46082, Type 2)), remove all compound residue.

1. C. (1) (f) Remove nuts and washers securing shipping cover on forward face of accessory drive gearbox. Remove cover and gasket.

(g) Remove oil drain plug and packing from accessory drive gearbox and drain oil into suitable container.

(h) Remove nuts and washers and remove support brackets.

(i) Remove plug and packing.

(2) Install splined shaft and gearbox hardware. (See figure 203.)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(a) Pack spline cavity of each drive spline on forward face of accessory drive gearbox with one of the following lubricants:

Grease (Aeroshell 17 (MIL-G-21164))

Grease (Aeroshell 22 (MIL-G-81322))

Grease (MIL-G-21164)

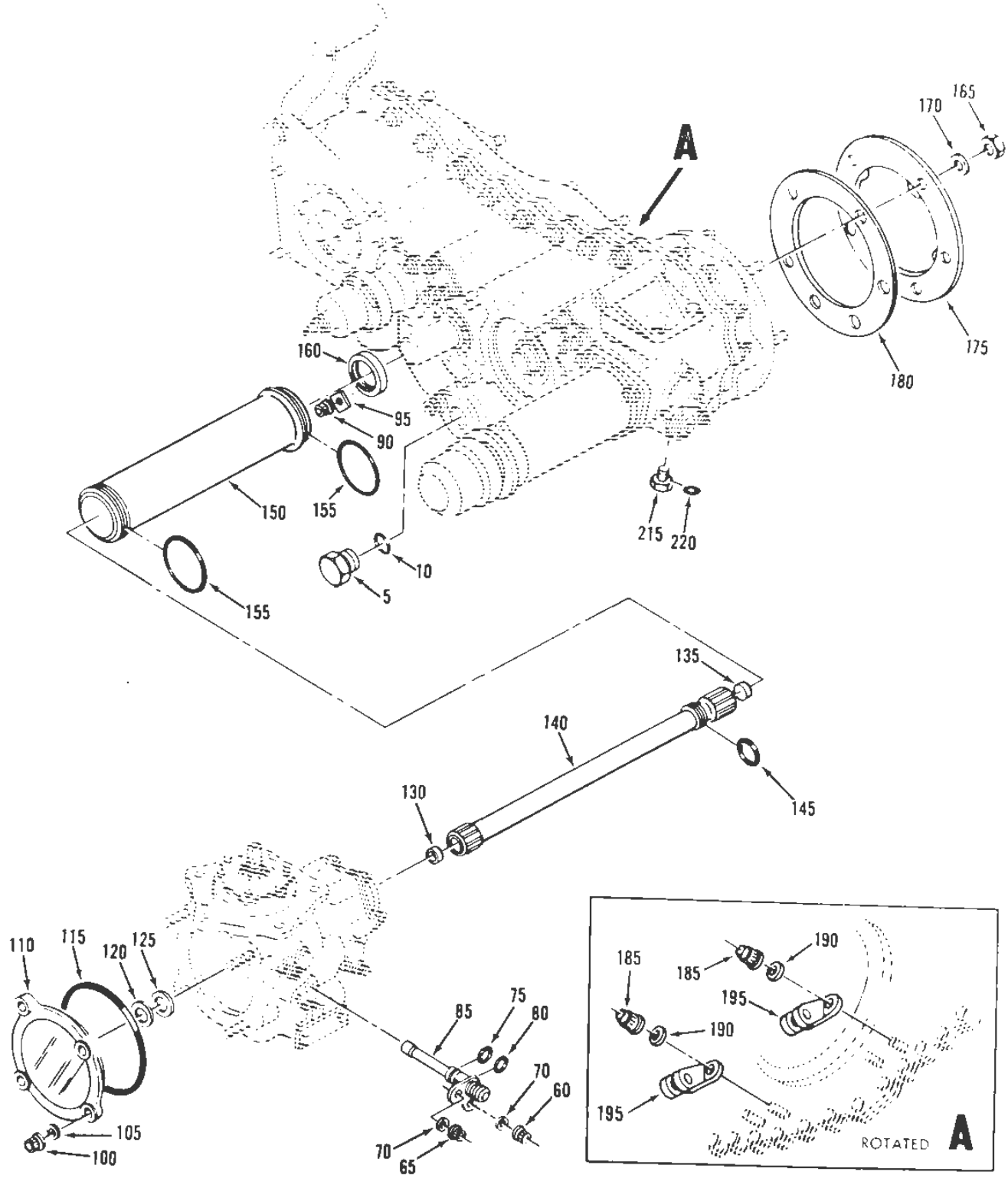
Grease (Mobil Grease No. 28) (MIL-G-81322)

Grease (Mobil Grease No. 29) (Molybdenum-disulphide)(MIL-G-81827)

(b) Install oil drain plug and packing. Tighten oil drain plug (5) to torque of 160 inch-pounds.

(c) On forward face of accessory drive gearbox install new gasket and shipping cover and secure with nuts and washers. Tighten nuts (165) to torque of 40 to 70 inch-pounds.

(d) If removed, install new packing on plug and install plug. Tighten plug (215) to torque of 65 to 70 inch-pounds.



Splined Shaft and Gearbox Hardware Installation
Figure 203

1. C. (2) (e) Install seal in transfer shaft cover tube as follows.

1) Thoroughly clean mating surfaces of seal and transfer shaft cover tube with 1,1,1-Trichloroethane (MIL-T-81533) to remove all oil residue. Dry parts.

2) Coat mating surfaces of seal and transfer shaft cover tube with primer (MIL-S-22473, Grade T), then allow primer to dry for ten to fifteen minutes.

3) Coat mating surfaces of seal and transfer shaft cover tube with compound (Loctite 40 or 640 (MIL-R-46082, Type 2)). Support transfer shaft cover tube and press seal into bore of transfer shaft cover tube using 291475-1 driver.

4) Heat cure compound (Loctite 40 or 640 (MIL-R-46082, Type 2)) with 427C (800F) heat gun for one minute, or cure compound at room temperature for three hours.

(f) Install packings on transfer shaft cover tube.

KEY TO FIGURE 203

5.	OIL DRAIN PLUG (IPC FIG. 65)	*130.	PLUG
10.	PACKING	*135.	PLUG
60.	NUT (IPC FIG. 64)	140.	SPLINED SHAFT
65.	NUT	145.	PACKING
70.	WASHER	150.	TRANSFER SHAFT COVER TUBE
75.	PACKING	155.	PACKING
80.	PACKING	160.	SEAL
85.	OIL JET	165.	NUT
90.	NUT	170.	WASHER
95.	RETAINER	175.	SHIPPING COVER
100.	NUT	180.	GASKET
105.	WASHER	185.	NUT
110.	TRANSFER GEARBOX COVER	190.	WASHER
115.	PACKING	195.	SUPPORT BRACKET
120.	RETAINING RING	215.	PLUG
125.	THRUST WASHER	220.	PACKING

*NOT REMOVED AT MAINTENANCE LEVEL

1. C. (2) (g) Install transfer shaft cover tube with packings and seal in accessory drive gearbox. Use 2914/4-1 pilot to guide seal over mating shaft in accessory drive gearbox.

(h) Install new packings on splined shaft.

(i) Install splined shaft in transfer gearbox from forward bore. Install thrust washer (with slotted side toward splined shaft) and retaining ring in bevel gear bore of transfer gearbox to secure splined shaft.

(j) Install new packings on oil jet; install oil jet in transfer gearbox and secure with nuts and washers. Tighten nuts (60, 65) to torque of 27 inch-pounds.

(k) Install transfer gearbox cover with packing, then secure with nuts and washers. Tighten nuts (100) to torque of 30 inch-pounds.

R (l) Position splined shaft inside cover tube. Install splined shaft so that shaft is engaged in internal splines of accessory drive gearbox shaft and cover tube fits into opening of transfer gearbox.

R (m) Install retainer on stud and secure transfer shaft
R cover tube with nut. Tighten nut (90) to torque of 27 inch-pounds.

(n) Install support brackets and secure with washers and nuts. Tighten nuts (185) to torque of 70 inch-pounds.

(o) Install tower shaft housing and forward mounting struts. Refer to paragraph 1.B.

(p) Install accessory and transfer gearbox module. Refer to paragraph 1.A.

1. D. Removal and Installation of Transfer Gearbox

(1) Remove transfer gearbox as follows. (See figure 204.)

(a) (Code A) Disconnect engine wiring harness from N2 transducer in accordance with 72-00-02, MAINTENANCE PRACTICES.

(b) Remove fuel and P3 sensing lines installation in accordance with 73-10-02, MAINTENANCE PRACTICES.

(c) Remove fuel system installation in accordance with 73-20-01, MAINTENANCE PRACTICES.

(d) Remove tube assemblies and tee connector between transfer gearbox and accessory drive gearbox.

(e) Remove nut and retainer securing oil scavenge tube and slide oil scavenge tube into transfer gearbox to clear lube and scavenge pump.

(f) Remove nuts and washers securing transfer gearbox cover and packing, then remove transfer gearbox cover and packing.

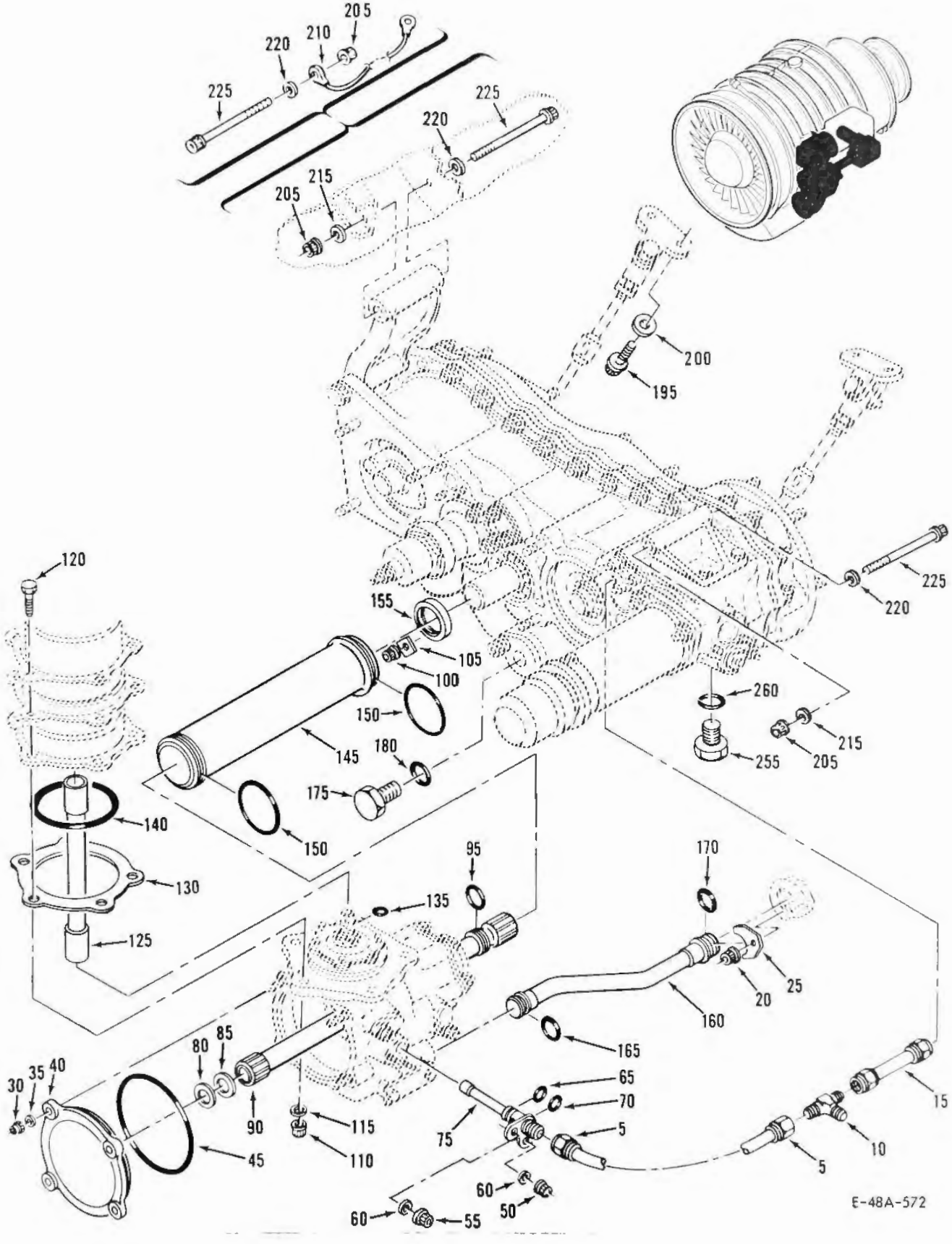
(g) Remove nuts and washers securing oil jet, then remove oil jet with packings.

(h) Remove retaining ring and thrust washer from bore of bevel gear within transfer gearbox. Withdraw splined shaft with packing from splines of accessory drive gearbox.

(i) Remove nut and retainer securing transfer shaft cover tube to accessory drive gearbox and slide tube into transfer gearbox to clear accessory drive gearbox.

NOTE: Ensure number of thickness of shims removed are recorded. A record of originally installed shim thickness is required for reassembly.

(j) Remove nuts and washers used on bolts securing transfer gearbox to engine. (Bolt will remain with tower shaft housing lower flange.) Remove shims and packings from transfer gearbox upper face. Note number and thickness of shims removed. Remove shouldered shaft from tower shaft housing on engine. Remove packings and shims.



Transfer Gearbox and Accessory Drive Gearbox
Figure 204

1. D. (1) (k) Remove transfer shaft cover tube with packings and seal, splined shaft with packing, and oil scavenge tube with packings. Remove packings and seal. If seal was previously installed in transfer shaft cover tube with compound (Loctite 40 or 640 (MIL-R-46082, Type 2)), remove all compound residue.

(2) Install transfer gearbox as follows. (See figure 204.)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(a) Install new packings on transfer gearbox shouldered shaft and flange mating with tower shaft housing. Install new packings on oil scavenge tube.

KEY TO FIGURE 204

5.	TUBE ASSY (IPC FIG. 62)	125.	SHOULDERED SHAFT (IPC FIG. 62)
10.	TEE	130.	SHIM
15.	TUBE ASSY	135.	PACKING
20.	NUT (IPC FIG. 49)	140.	PACKING
25.	RETAINER	145.	TRANSFER SHAFT COVER TUBE (IPC FIG. 64)
30.	NUT (IPC FIG. 64)	150.	PACKING
35.	WASHER	155.	SEAL
40.	TRANSFER GEARBOX COVER	160.	OIL SCAVENGE TUBE (IPC FIG. 49)
45.	PACKING	165.	PACKING
50.	NUT	170.	PACKING
55.	NUT	175.	OIL DRAIN PLUG (IPC FIG. 65)
60.	WASHER	180.	PACKING
65.	PACKING	195.	BOLT (IPC FIG. 62)
70.	PACKING	200.	WASHER
75.	OIL JET	205.	NUT
80.	RETAINING RING	210.	(CODE A) GROUNDING CABLE
85.	THRUST WASHER	215.	WASHER
90.	SPLINED SHAFT	220.	WASHER
95.	PACKING	225.	BOLT
100.	NUT	255.	PLUG (IPC FIG. 64)
105.	RETAINER	260.	PACKING
110.	NUT (IPC FIG. 62)		
115.	WASHER		
120.	BOLT (IPC FIG. 63)		

1. D. (2) (b) If different transfer gearbox is being installed, determine shim thickness required as specified in step 1.A.(2)(a). If same transfer gearbox is being reinstalled, use thickness of shims noted at removal.

(c) Install shims on transfer gearbox.

R (d) If assembled, remove nuts, washers, transfer gearbox cover, and packing from transfer gearbox. Remove nuts, washers, oil jet, and packings.

(e) Slide splined shaft through bevel gear in transfer gearbox and install packing. Position splined shaft fully aft in transfer gearbox. Slide oil scavenge tube into transfer gearbox.

(f) Install seal in transfer shaft cover tube as follows

1) Thoroughly clean mating surfaces of seal and transfer shaft cover tube with 1,1,1-Trichloroethane (MIL-T-81533) to remove all oil residue. Dry parts.

2) Coat mating surfaces of seal and transfer shaft cover tube with primer (MIL-S-22473, Grade T), then allow primer to dry for ten to fifteenminutes.

3) Coat mating surfaces of seal and transfer shaft cover tube with compound (Loctite 40 or 640 (MIL-R-46082, Type 2)). Support transfer shaft cover tube and press seal into bore of transfer shaft cover tube using 291475-1 driver.

4) Heat cure compound (Loctite 40 or 640 (MIL-R-46082, Type 2)) with 427C (800F) heat gun for one minute, or cure compound at room temperature for three hours.

(g) Install packings on transfer shaft cover tube. Install cover tube with seal and packings into accessory drive gearbox using 291474-1 pilot. Secure cover tube with nuts and retainer. Tighten nut (100) to torque of 27 inch-pounds.

1. D. (2) (h) Install shouldered shaft in tower shaft housing. Install transfer gearbox on tower shaft housing with forward end of splined shaft inside cover tube and cover tube engaged in transfer gearbox. Secure transfer gearbox with nuts, bolts, and washers. Tighten nuts (110) to torque of 100 inch-pounds.

(i) Slide splined shaft forward to engage accessory drive gearbox splines. Install thrust washer
R (with slotted side toward splined shaft) and new retaining ring in bore of bevel gear of transfer gearbox.

(j) Install packings on oil jet and install oil jet. Secure oil jet with nuts and washers. Tighten nuts (50, 55) to torque of 27 inch-pounds.

(k) Install packing and transfer gearbox cover on transfer gearbox and secure with nuts and washers. Tighten nuts (30) to torque of 30 inch-pounds.

(l) Slide oil scavenge tube forward to engage accessory drive gearbox and secure with nut and retainer. Tighten nut (20) to torque of 27 inch-pounds.

(m) Install tube assemblies and tee between accessory drive gearbox and transfer gearbox.

(n) Install fuel system installation in accordance with 73-20-01, MAINTENANCE PRACTICES.

(o) Install fuel and P3 sensing lines installation in accordance with 73-10-02, MAINTENANCE PRACTICES.

(p) (Code A) Connect wiring harness to N2 transducer in accordance with 72-00-02, MAINTENANCE PRACTICES.

E. Removal and Installation of Accessory Drive Gearbox

(1) Remove accessory drive gearbox as follows. (See figure 204.)

(a) (Code A) Disconnect engine wiring harness from fuel control connector and fuel control torque motor in accordance with 72-00-02, MAINTENANCE PRACTICES.

1. E. (1) (b) Disconnect oil fittings from accessory drive gearbox and fuel tubes from fuel pump in accordance with 79-20-06, MAINTENANCE PRACTICES.

(c) Remove oil temperature regulator (fuel/oil cooler) oil and fuel tubes in accordance with 79-20-07, MAINTENANCE PRACTICES.

(d) Remove tubes from oil tank to oil pump and accessory drive gearbox in accordance with 79-10-01, MAINTENANCE PRACTICES.

(e) Remove fuel and P3 sensing lines installation in accordance with 73-10-02, MAINTENANCE PRACTICES.

(f) Remove oil drain plug and packing from accessory drive gearbox and drain oil into a suitable container.

(g) Remove oil pump and chip detector installation in accordance with 79-20-03, MAINTENANCE PRACTICES.

(h) Remove fuel system installation in accordance with 73-20-01, MAINTENANCE PRACTICES.

(i) Remove tube assemblies and tee connector between transfer gearbox and accessory drive gearbox.

(j) Remove nuts and washers securing transfer gearbox cover and packing. Remove cover and packing.

(k) Remove nuts and washers securing oil jet, then remove oil jet with packings.

(l) Remove retaining ring and thrust washer from bore of bevel gear within transfer gearbox. Withdraw splined shaft with packing from splines of accessory drive gearbox.

(m) Remove nut and retainer securing transfer shaft cover tube to accessory drive gearbox and slide tube into transfer gearbox to clear accessory drive gearbox.

(n) (Code A) Disconnect grounding cable from aircraft. Refer to Aircraft Maintenance Manual.

(o) (Code A) If installed, remove clamp on grounding cable by removing nut, bolt, and washer securing clamp and grounding cable to oil filler tube, then remove clamp.

R 1. E. (1) (p) (Code A Pre SB72-3092) Remove nuts, washers, grounding cable, and bolts securing accessory drive gearbox to engine and remove accessory drive gearbox.

R (p1) (Code A Post SB72-3092) Remove nuts, washers,
R grounding cable, and bolts securing accessory
R drive gearbox to engine and remove accessory drive
R bearbox. If required remove bushings (/2, figure
R 201).

(q) (Codes B, C) Remove nuts, washers, and bolts securing accessory drive gearbox to engine and remove accessory drive gearbox.

(r) Remove plug and packing.

(s) Remove forward mounting struts. Refer to paragraph 1.B.

(t) Remove nuts and washers securing shipping cover and gasket. Remove cover and gasket. (See figure 203.)

(u) Remove transfer shaft cover tube, then remove packings and seal. If seal was previously installed in transfer shaft cover tube with compound (Loctite 40 or 640 (MIL-R-46082, Type 2)), remove all compound residue.

(v) Remove packing from splined shaft.

(2) Install accessory drive gearbox as follows. (See figure 204.)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (rundown) torque of self-locking devices to recommended values.

(a) Pack spline cavity and all recessed surfaces of each drive spline on forward face of accessory drive gearbox with one of the following lubricants:

Grease (Aeroshell 17 (MIL-G-21164))

Grease (Aeroshell 22 (MIL-G-81322))

Grease (MIL-G-21164)

Grease (Mobil Grease No. 28) (MIL-G-81322)

Grease (Mobil Grease No. 29) (Molybdenum-disulphide) (Mil-G-81827)

1. E. (2) (b) Install forward mounting struts. Refer to paragraph 1.B.

(c) Install plug with packing and shipping cover and gasket. Secure shipping cover with nuts and washers. Tighten nuts (165, figure 203) to torque of 40 to 70 inch-pounds and plug (255, figure 204) to torque of 65 to 70 inch-pounds.

(d) Install oil drain plug with packing. Tighten oil drain plug (175) to torque of 160 inch-pounds.

(e) Install seal in transfer shaft cover tube as follows.

1) Thoroughly clean mating surfaces of seal and transfer shaft cover tube with 1,1,1-Trichloroethane (MIL-T-81533) to remove all oil residue. Dry parts.

2) Coat mating surfaces of seal and transfer shaft cover tube with primer (MIL-S-22473, Grade T), then allow primer to dry for ten to fifteenminutes.

3) Coat mating surfaces of seal and transfer shaft cover tube with compound (Loctite 40 or 640 (MIL-R-46082, Type 2)). Support transfer shaft cover tube and press seal into bore of transfer shaft cover tube using 291475-1 driver.

4) Heat cure compound (Loctite 40 or 640 (MIL-R-46082, Type 2)) with 427C (800F) heat gun for one minute, or cure compound at room temperature for three hours.

(f) Install packings on transfer shaft cover tube. Install transfer shaft cover tube with packings and seal in accessory drive gearbox using 291474-1 pilot.

(g) Loosen nut securing accessory drive gearbox housing support (figure 201, 72-60-02) to gearbox.

R 1. E. (2) (h) (Code A Pre SB72-3092) Install accessory drive gearbox on engine and secure with bolts, washers, grounding cable, and nuts. Tighten nuts (205, figure 204) to torque of 100 to 120 inch-pounds. Tighten nut (105, figure 201, 72-60-02) on accessory drive gearbox housing support to torque of 60 inch-pounds.

R (h1) (Code A Post SB72-3092) If removed, install bushings (72, figure 201), then install accessory drive gearbox on engine and secure with bolts, washers, grounding cable, and nuts. Tighten nuts (205, figure 204) to torque of 70 inch-pounds. Tighten nuts (105, figure 201, 72-60-02) on accessory drive gearbox housing support to torque of 60 inch-pounds.

1. E. (2) (i) (Code A) If removed at disassembly, install clamp on grounding cable and secure grounding cable with clamp, nut, washer, and bolt. Tighten nut to torque of 45 inch-pounds. Attach free end of grounding cable to aircraft in accordance with Aircraft Maintenance Manual.

(j) (Codes B, C) Install accessory drive gearbox on engine and secure with bolts, washers, and nuts. Tighten nuts (205, figure 204) to torque of 100 to 120 inch-pounds. Tighten nut (105, figure 201, 72-60-02) on accessory drive gearbox housing support to torque of 60 inch-pounds.

(k) Install new packing on splined shaft. Slide splined shaft forward to engage accessory drive gearbox splines. Install thrust washer (with slotted side toward shaft) and new retaining ring in bore of bevel gear of transfer gearbox.

(l) Install packings on oil jet, then install oil jet. Secure oil jet with nuts and washers. Tighten nuts (50, 55) to torque of 27 inch-pounds.

(m) Install packing and transfer gearbox cover, then secure with nuts and washers. Tighten nuts (30) to torque of 30 inch-pounds. Position support struts on engine and secure with bolts and washers. Tighten bolts (195) to torque of 70 inch-pounds. If loosened, tighten nuts (35, 45, figure 202) against rod ends to torque of 100 inch-pounds.

(n) Install fuel system installation in accordance with 73-20-01, MAINTENANCE PRACTICES.

(o) Install oil pump and chip detector installation in accordance with 79-20-03, MAINTENANCE PRACTICES.

(p) Install tube assemblies and tee between accessory drive gearbox and transfer gearbox.

(q) Install fuel and P3 sensing lines installation in accordance with 73-10-02, MAINTENANCE PRACTICES.

(r) Secure transfer shaft cover tube with nut and retainer. Tighten nut (100, figure 204) to torque of 27 inch-pounds.

(s) Install tubes from oil tank to oil pump and accessory drive gearbox in accordance with 79-10-01, MAINTENANCE PRACTICES.

1. E. (2) (t) Install oil temperature regulator (fuel/oil cooler) oil and fuel tubes in accordance with 79-20-07, MAINTENANCE PRACTICES.

(u) Connect oil fittings to accessory drive gearbox and fuel tubes to fuel pump in accordance with 79-20-06, MAINTENANCE PRACTICES.

(v) (Code A) Connect engine wiring harness to fuel control and fuel control torque motor in accordance with 72-00-02, MAINTENANCE PRACTICES.

2. Inspection/Check

A. Inspection of Accessory and Transfer Gearbox Module

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Inspect oil transfer tube for flare cracks, dents which cause a crease or reduce diameter more than ten percent, or other damage.

(2) Remove nuts and washers securing transfer gearbox cover and packing and check bevel gearshaft (figure 202, 72-60-03) for abnormal wear pattern, excessive wear, or chipped or broken teeth. Reinstall cover with packing and secure with nuts and washers. Tighten nuts (100, figure 203) to torque of 30 inch-pounds.

(3) Inspect vertical and horizontal bevel gearshaft (figure 202, 72-60-03) splines for wear (0.002 inch maximum permissible).

(4) Inspect shouldered shaft splines for evidence of wear (0.002 inch maximum permissible).

(5) Inspect splines of accessory drive gearbox shafts as follows.

(a) Clean splines on accessory drive gearbox with solvent (Shell 360).

2. A. (5) (b) Inspect splines on accessory drive gearbox for wear. Maximum allowable depth of internal spline wear, measured at pitch line of tooth, is a nominal 0.010 inch. Determine wear depth by comparing maximum wear area on spline with end where there is no wear. This "no wear" area is normally at extreme aft end of spline where there is no engagement with mating spline of accessory. If allowable wear limit is exceeded, remove and replace gearshafts in accordance with 72-60-02, MAINTENANCE PRACTICES.

(6) Replace item if inspection requirements of steps (1) through (5) are not met.

B. Inspection of Tower Shaft Housing and Forward Mounting Struts

(1) Inspect tower shaft housing for cracks or corrosion.

(2) Inspect struts for cracks or wear.

(3) Inspect rod-end bearings for cracks or wear.

R (4) Inspect tower shaft housing for evidence of chafing
R with bottom panel. Refer to 4, Approved Repairs if
R housing shows evidence of chafing.

(5) Replace items if inspection requirements of steps (1) through (3) are not met.

C. Inspection of Splined Shaft and Gearbox Hardware

(1) Inspect splined shaft splines for wear (0.002 inch maximum permissible).

(2) Inspect seal for damage.

(3) Replace items that do meet inspection requirements of steps (1) and (2).

D. Inspection of Damaged Paint or Corrosion on Gearbox Housings

(1) Inspect accessory drive gearbox and transfer gearbox housings for damaged paint and evidence of corrosion. Refer to 72-60-02, MAINTENANCE PRACTICES (accessory drive gearbox) or to 72-60-03, MAINTENANCE PRACTICES (transfer gearbox) for touch-up painting or repair of corrosion.

3. Cleaning/Painting

A. Clean Parts

CAUTION: METHANOL (METHYL OR WOOD ALCOHOL) SHALL NOT BE USED AS A CLEANING AGENT WHEN CLEANING MAGNESIUM HOUSINGS OF ACCESSORY DRIVE AND TRANSFER GEARBOXES. PROLONGED CONTACT OF METHANOL WITH UNPROTECTED MAGNESIUM COMPONENT WILL DESTROY COMPONENT. USE OF METHANOL WITH MAGNESIUM COMPONENTS IS AUTHORIZED ONLY AS SPECIFICALLY INSTRUCTED FOR REPAIR OF CORRODED SURFACES.

(1) Clean parts as specified in Table 203 in accordance with cleaning methods in 72-00-00, GENERAL - CLEANING/PAINTING.

Table 203. Cleaning Methods

Figure No.	Item No.	Nomenclature	Cleaning Methods 1	2	3	4	5	6	7	8	9	10	11	12
All standard metallic hardware			X	X										
201	5	Tube Assy												X
	15	Tee												X
	20	Tube Assy												X
	95	Shim	X	X										
	110	Shouldered Shaft	X	X										
202	70	Oil Transfer Tube												X
	80	Retainer Plate	X	X										
	85	Seal	X	X										
	90	Tower Shaft Housing	X	X										

Table 203. Cleaning Methods (Cont)

Figure No.	Item No.	Nomenclature	Cleaning Methods 1	2	3	4	5	6	7	8	9	10	11	12
203	85	Oil Jet												X
	110	Transfer Gearbox Cover	X	X										
	120	Retaining Ring	X	X										
	125	Thrust Washer	X	X										
	130, 135, 140	Splined Shaft	X	X										
	150	Transfer Shaft Cover Tube												X
	175	Shipping Cover	X	X										
204	5	Tube Assy												X
	10	Tee												X
	15	Tube Assy												X
	40	Transfer Gearbox Cover	X	X										
	75	Oil Jet												X
	80	Retaining Ring	X	X										
	85	Thrust Washer	X	X										
	90	Splined Shaft	X	X										
	130	Shim	X	X										
	145	Transfer Shaft Cover Tube												X
	160	Oil Scavenge Tube												X

R 4. Approved Repairs

R A. Blend Repair Tower Shaft Housing

R Blend chafed areas on tower shaft housing to remove any
R sharp edges. Refer to 79-20-09, 4, Approved Repairs for
R rework of bottom panel to prevent further chafing of tower
R shaft housing.

ACCESSORY DRIVE GEARBOX ASSEMBLY - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Special Tools, Fixtures and Equipment

Item No.	Nomenclature	Use	Source/ Part No.
NOTE: Equivalent substitutes may be used for listed items.			
1.	Seal Installation and Removal Driver	Removes and installs seal on fuel control gearshaft and hydraulic pump gearshaft.	289801-1
2.	Seal Installation and Removal Driver	Removes and installs seal on alternator gearshaft, and starter/generator gearshaft.	289801-2
3.	Seal Installation Pilot	Guides seal over gearshaft.	289802-1
4.	Seal Installation Pilot	Guides seal over gearshaft.	289802-2
5.	Seal Installation Pilot	Guides seal over gearshaft.	289802-3
6.	Bearing Driver	Installs bearings.	289806-1
7.	Bearing Driver	Installs bearings.	289807-1
8.	Seal Removal Puller Set	Removes seal from breather pressurizing valve.	289808-1
9.	Torque Wrench Adapter	Adapts bearing retainer nut for standard torque wrench.	289817-1 or 289817-2
10.	Bearing Removal Puller and Adapter	Removes bearings.	289903-1

Table 201. Special Tools, Fixtures and Equipment (Cont)

Item No.	Nomenclature	Use	Source/ Part No.
11.	Bearing Removal Puller and Adapter	Removes bearings.	289904-1
12.	Seal Retainer Mechanical Puller	Removes seal retainers.	291280-1

Table 202. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Grease (MIL-G-23827)	Commercially available

NOTE: Refer to 72-60-01 for Removal/Installation of accessory drive gearbox on engine.

1. A. Remove External Components (See Figure 201)

(1) Remove nut and washer securing chip detector adapter, then remove chip detector adapter with two packings.

(2) Remove breather pressurizing valve with attached seal and packing in accordance with 79-20-02, MAINTENANCE PRACTICES.

(3) Remove oil filter and cover components in accordance with 79-20-01, MAINTENANCE PRACTICES.

R (3a) Remove oil filter bypass indicator valve installation
R in accordance with 79-30-01, MAINTENANCE PRACTICES.

(4) Remove nuts and washers securing two oil jets. Remove oil jet plug with packing, then oil jets with packings.

(5) Remove nut, washers, and bolt securing housing support, then remove housing support.

1. A. (6) Remove bolts and washers securing mount assembly, then remove mount assembly.

(7) Do not remove identification plate or attaching screws unless necessary to replace parts.

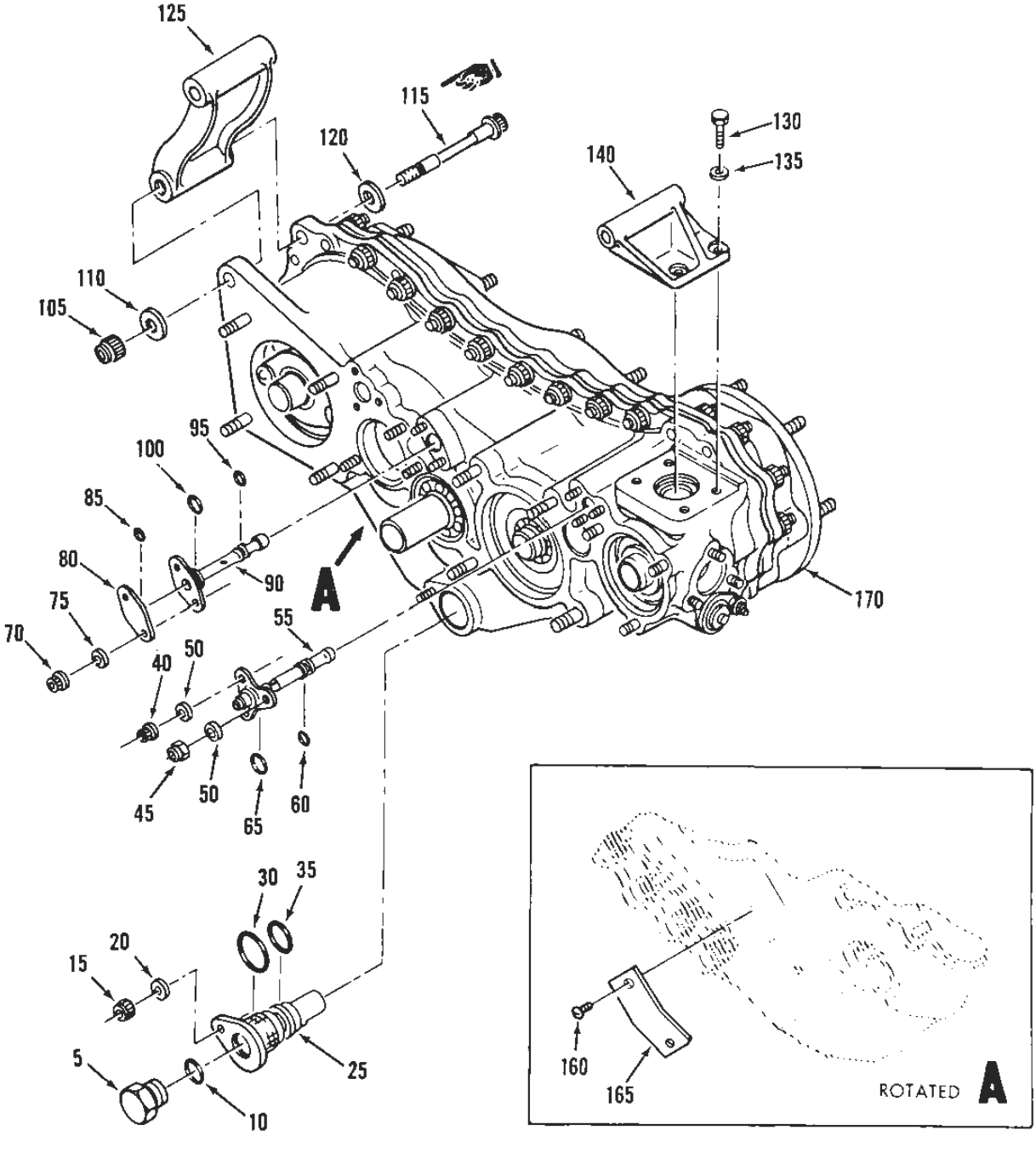
B. Remove Accessory Gearbox Cover (See Figure 202)

(1) Remove screws and washers securing assembled seal retainer, packing, and fuel control and pump gearshaft aft seal. Remove seal retainer with assembled items using 291280-1 puller. Remove packing from seal retainer.

NOTE: Removal of fuel control and pump gearshaft aft seal from seal retainer is not required unless damage is indicated by inspection.

(2) Remove fuel control and pump gearshaft aft seal from seal retainer using 289801-1 driver.

(3) Place gearbox on bench with accessory gearbox cover facing up.

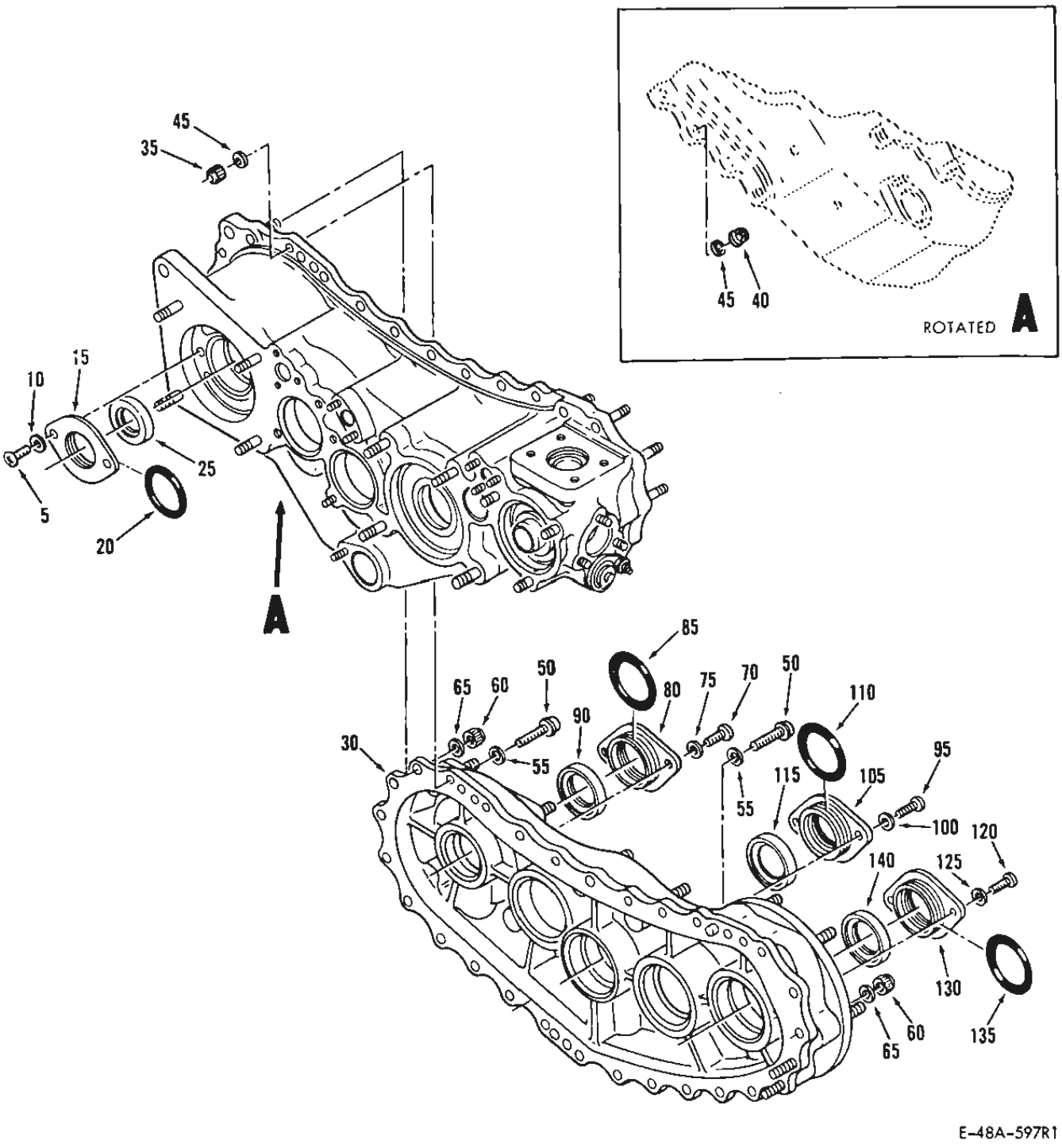


Accessory Drive Gearbox Assembly
Figure 201

KEY TO FIGURE 201

5.	OIL DRAIN PLUG (IPC FIG. 65)	85.	PACKING
10.	PACKING	90.	OIL JET
15.	NUT	95.	PACKING
20.	WASHER	100.	PACKING
25.	CHIP DETECTOR ADAPTER	105.	NUT
30.	PACKING	110.	WASHER
35.	PACKING	115.	BOLT
40.	NUT (IPC FIG. 66)	120.	WASHER
45.	NUT	125.	HOUSING SUPPORT
50.	WASHER	130.	BOLT
55.	OIL JET	135.	WASHER
60.	PACKING	140.	MOUNT ASSY
65.	PACKING	160.	SCREW
70.	NUT	165.	IDENTIFICATION PLATE
75.	WASHER	170.	GEARBOX
80.	OIL JET PLUG		

R



Accessory Gearbox Cover
Figure 202

KEY TO FIGURE 202

R 5. SCREW (IPC FIG. 67)
R 10. WASHER
R 15. SEAL RETAINER
R 20. PACKING
R 25. FUEL CONTROL AND PUMP
R GEARSHAFT AFT SEAL
R 30. ACCESSORY GEARBOX COVER
R 35. NUT
R 40. NUT
R 45. WASHER
R 50. BOLT
R 55. WASHER
R 60. NUT
R 65. WASHER
R 70. SCREW
R 75. WASHER
R 80. SEAL RETAINER
85. PACKING
90. FUEL CONTROL AND PUMP GEARSHAFT FORWARD SEAL
95. SCREW
100. WASHER
105. SEAL RETAINER
110. PACKING
115. STARTER-GENERATOR GEARSHAFT SEAL
120. SCREW
125. WASHER
130. SEAL RETAINER
135. PACKING
140. ALTERNATOR GEARSHAFT SEAL

1. B. (4) Remove nuts, washers, and bolts securing accessory gearbox cover to aft section of gearbox.

CAUTION: SEPARATE ACCESSORY GEARBOX COVER WITH CARE TO AVOID DROPPING PORTIONS OF THE GEARTRAIN AND/OR GEARSHAFT BEARINGS.

NOTE: Gearshaft bearings may remain with accessory gearbox cover when cover is removed.

(5) Separate accessory gearbox cover from aft section using screws in ports provided on cover. Tap cover with rawhide mallet (or equivalent) while turning screws in a jackscrew manner. Remove cover and screws when separation is completed. Put accessory drive gears and aft section aside until cover disassembly is completed.

(6) Remove screws and washers securing assembled seal retainer, packing, and fuel control and pump gearshaft forward seal. Remove seal retainer with assembled items using 291280-1 puller. Remove packing from seal retainer.

NOTE: Removal of fuel control and pump gearshaft forward seal from seal retainer is not required unless damage is indicated by inspection.

(7) Remove fuel control and pump gearshaft forward seal from seal retainer using 289801-1 driver.

(8) Remove screws and washers securing assembled seal retainer, packing, and starter-generator gearshaft seal. Remove seal retainer with assembled items using 291280-1 puller. Remove packing from seal retainer.

NOTE: Removal of stater-generator gearshaft seal from seal retainer is not required unless damage is indicated by inspection.

(9) Remove starter-generator gearshaft seal from seal retainer using 289801-2 driver.

(10) Remove screws and washers securing assembled seal retainer, packing, and alternator gearshaft seal. Remove seal retainer with assembled items using 291280-1 puller. Remove packing from seal retainer.

NOTE: Removal of alternator gearshaft seal from seal retainer is not required unless damage is indicated by inspection.

1. B. (11) Remove alternator gearshaft seal from seal retainer using 289801-2 driver.

C. Disassemble Accesssory Drive Housing Assembly (See Figure 203)

R (1) Deleted.

(2) Remove gasket from mating flange of accessory drive housing assembly.

(3) Remove fuel control and pump gearshaft with assembled parts from accessory drive housing assembly. Do not remove plug from gearshaft unless damage is indicated by inspection. If removal is necessary, replace plug in accordance with good shop practice.

(4) Using arbor press and 289903-1 puller and adapter, remove bearings from fuel control and pump gearshaft.

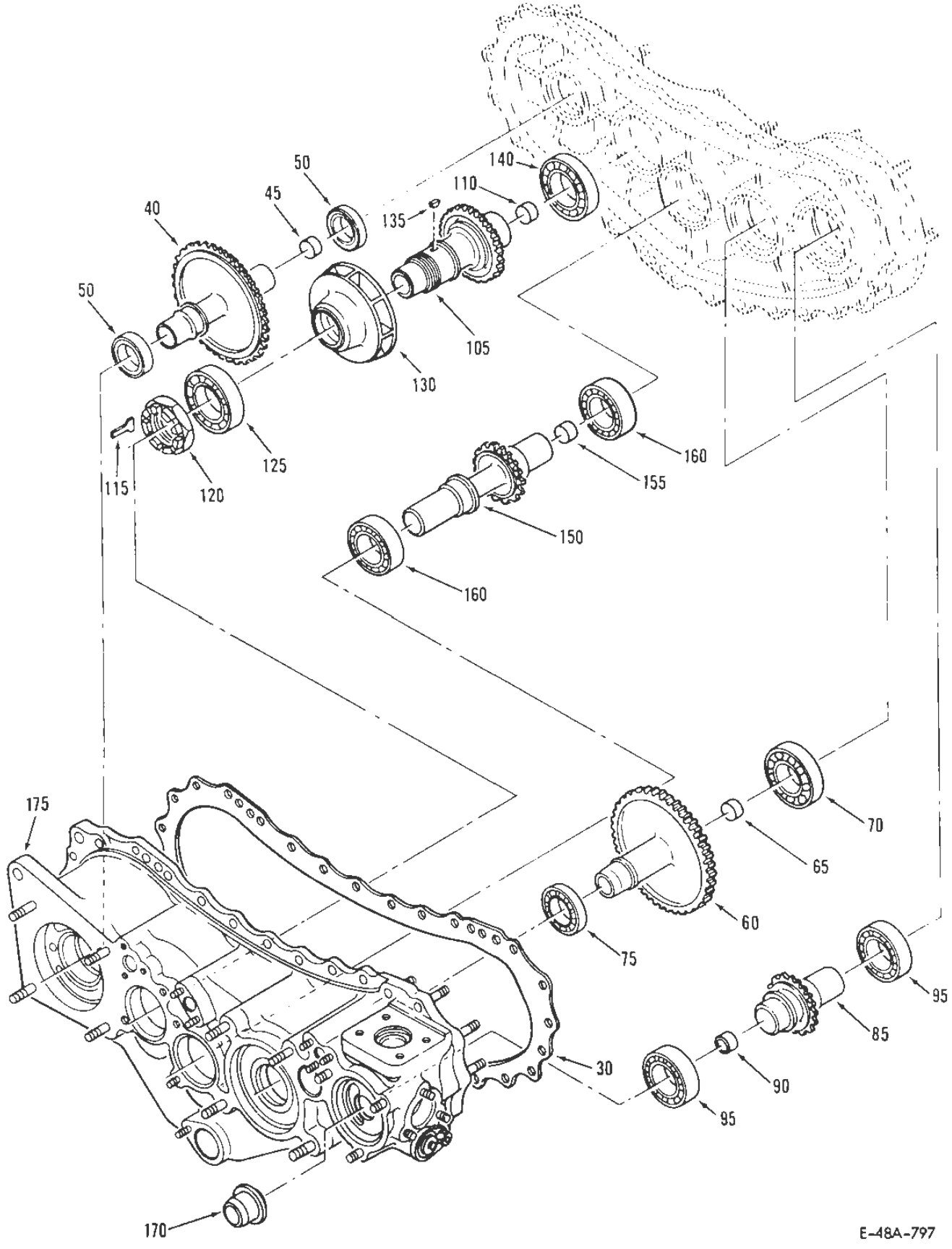
(5) Remove oil pump gearshaft with assembled parts from accessory drive housing assembly. Do not remove plug from gearshaft unless damage is indicated by inspection. If removal is necessary, replace plug in accordance with good shop practice.

R (6) Using arbor press and 289903-1 puller and adapter
R remove bearing (75) from oil pump gearshaft. Using ar-
R bor press and 289904-1 puller and adapter remove bear-
R ing (70) from oil pump gearshaft.

(7) Remove alternator gearshaft with assembled parts from accessory drive housing assembly. Do not remove plug from gearshaft unless damage is indicated by inspection. If removal is necessary, replace plug in accordance with good shop practice.

(8) Using arbor press and 289904-1 puller and adapter, remove bearings from alternator gearshaft.

(9) Remove air-oil separator gearshaft with assembled parts from accessory drive housing assembly. Do not remove plug from gearshaft unless damage is indicated by inspection. If removal is necessary, replace plug in accordance with good shop practice.



R

Accessory Drive Housing Assembly
Figure 203

KEY TO FIGURE 203

R	30.	GASKET (IPC FIG. 68)	110.	PLUG
	40.	FUEL CONTROL AND PUMP GEARSHAFT	115.	NUT LOCK KEY
	45.	PLUG	120.	NUT
	50.	BEARING	125.	BEARING
	60.	OIL PUMP GEARSHAFT	130.	AIR-OIL SEPARATOR
	65.	PLUG	135.	KEY
	70.	BEARING	140.	BEARING
	75.	BEARING	150.	STARTER-GENERATOR GEARSHAFT
	85.	ALTERNATOR GEARSHAFT	155.	PLUG
	90.	PLUG	160.	BEARING
	95.	BEARING	170.	FILTER ELEMENT SUPPORT
	105.	AIR-OIL SEPARATOR GEARSHAFT	175.	ACCESSORY DRIVE HOUSING ASSY

1. C. (10) Bend out nut lock key to allow rotation of nut. Using 289817-1 or 289817-2 torque wrench adapter with suitable handle, remove nut and nut lock key from air-oil separator gearshaft.

(11) Remove air-oil separator and key from air-oil separator gearshaft.

(12) Remove startor-generator gearshaft with assembled parts from housing assembly. Do not remove plug from gearshaft unless damage is indicated by inspection. If removal is necessary, replace plug in accordance with good shop practice.

(13) Using arbor press and 289904-1 puller and adapter, remove bearings from air-oil separator gearshaft.

R (14) Using arbor press and 289904-1 puller and adapter, remove bearings from starter-generator gearshaft.

NOTE: All internal gearbox components shall be coated with engine lubricating oil (72-00-00, GENERAL - SERVICING, Table 301) at assembly.

D. Assemble Accessory Drive Housing Assembly (See Figure 203)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Place housing assembly on clean paper covered bench. Inspect housing assembly cavity to ensure no foreign matter is present. Wet gear teeth of gearshafts with engine lubricating oil (72-00-00, GENERAL - SERVICING, Table 301).

(2) Using 289807-1 bearing driver, install bearings on starter-generator gearshaft. Ensure bearings bottom against shoulders on gearshaft.

(3) Handpress starter-generator gearshaft in place in accessory drive housing assembly. If required, tap gearshaft lightly with rawhide mallet to seat in place.

(4) Using 289807-1 bearing driver, install forward bearing on unthreaded end of air-oil separator gearshaft. Ensure bearing bottoms against shoulder on gearshaft.

(5) Install key in slot of air-oil separator gearshaft. Align keyway on air-oil separator with key and press air-oil separator in place of gearshaft.

1. D. (6) Using 289807-1 bearing driver, install aft bearing on air-oil separator gearshaft.

(7) Place nut lock key in slot of threaded end of air-oil separator gearshaft and install nut on threads. Using 289817-1 or 289817-2 torque wrench adapter, tighten nut (120) to torque of 250 to 500 inch-pounds. Loosen nut (120), then re-apply torque of 250 to 500 inch-pounds to ensure proper seating and to align nut lock key with a slot on nut. Bend nut lock key to lock nut in position.

(8) Handpress air-oil separator gearshaft into accessory drive housing assembly. If required, tap gearshaft lightly with rawhide mallet to seat in place.

(9) Using 289807-1 bearing driver, install bearings on alternator gearshaft. Ensure bearings bottom against shoulders on gearshaft.

(10) Handpress alternator gearshaft in place in accessory drive housing assembly. If required, tap gearshaft lightly with rawhide mallet to seat in place.

(11) Using 289806-1 bearing driver, install aft bearing on oil pump gearshaft. Using 289807-1 bearing driver, install forward bearing on oil pump gearshaft. Ensure bearings bottom against shoulders on gearshaft.

(12) Handpress oil pump gearshaft in place in accessory drive housing assembly. If required, tap gearshaft lightly with rawhide mallet to seat in place.

(13) Using 289806-1 bearing driver, install bearings on fuel control and pump gearshaft. Ensure bearings bottom against shoulders on gearshaft.

(14) Handpress fuel control and pump gearshaft in place in accessory drive housing assembly. If required, tap gearshaft lightly with rawhide mallet to seat in place.

(15) Install gasket on mating flange of housing assembly.

1. E. Assemble Accessory Gearbox Cover (See Figure 202)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Install accessory gearbox cover on housing assembly.

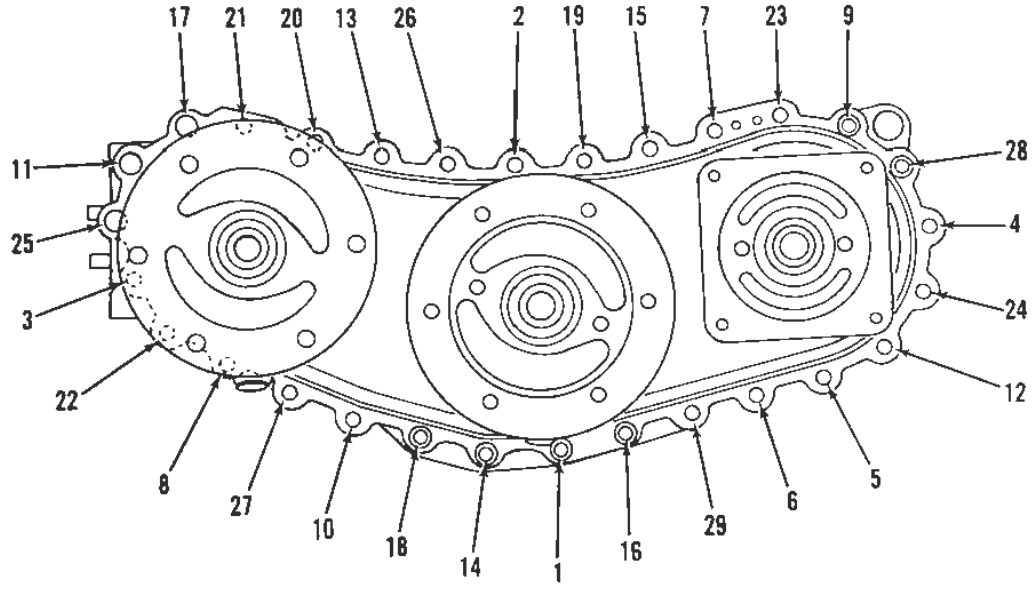
(2) Install washers and nut on studs of accessory drive housing assembly at flange mating with accessory gearbox cover to secure cover in place. Install bolts, washers, and nuts at through-hole locations. Tighten all nuts hand tight only.

(3) Tighten bolts and nuts at mating flange of housing assembly and accessory gearbox cover in the sequence of
R index numbers shown on Figure 204. Tighten nuts (35,
R 40, 60, figure 202) to torque of 60 inch-pounds.

(4) If removed at disassembly, install seals for alternator and starter-generator gearshafts in seal retainers using 289801-2 seal driver. Install seals with closed side of seal shell facing toward mating shoulder of seal retainer. Fill shaded area (figure 205) of seals with grease (MIL-G-23827).

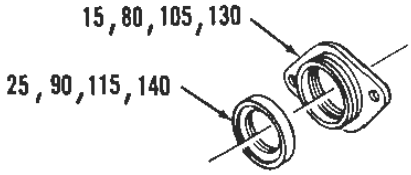
(5) If removed at disassembly, install forward and aft seals for fuel control and pump gearshaft in seal retainers using 289801-1 seal driver. Install seals with closed side of seal shell facing toward mating shoulder of seal retainer. Fill shaded area (figure 205) of seals with grease (MIL-G-23827).

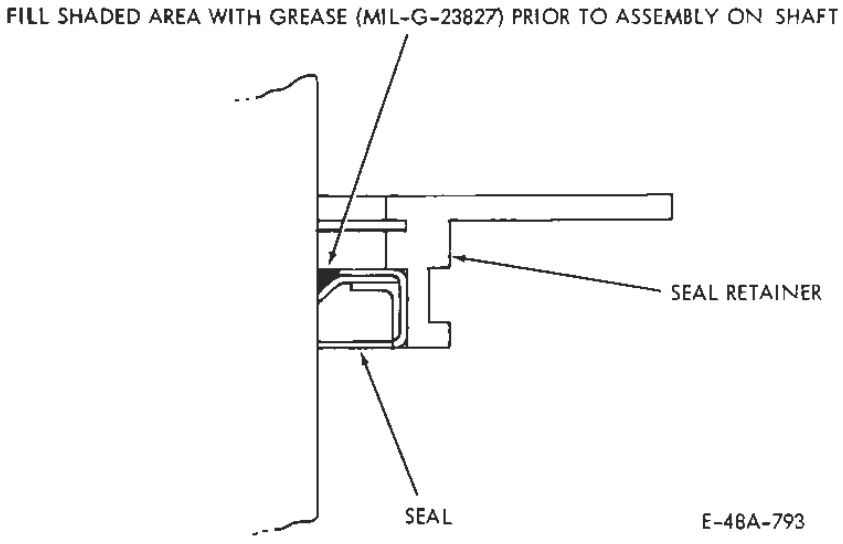
(6) Lightly coat packings for seal retainers with grease (MIL-G-23827) and install packings on seal retainers.



F-48A-146

Torque Sequence
Figure 204





R 15. SEAL RETAINER
R (IPC FIG.67)
R 25. SEAL
R 80. SEAL RETAINER
R 90. SEAL
105. SEAL RETAINER
115. SEAL
130. SEAL RETAINER
140. SEAL

Grease-Filled Area on Seals
Figure 205

1. E. (7) Lightly coat lip of each seal and mating shaft diameter with grease (MIL-G-23827).

(8) Carefully install assembled packings, seal retainers and seals for alternator and starter-generator gearshafts, using 289802-2 pilot. Secure seal retainers
R with washers and screws. Tighten screws (95, 120) to torque of 27 inch-pounds.

(9) Carefully install assembled packing, seal retainer, and forward seal for fuel control and pump gearshaft, using 289802-1 pilot. Secure seal retainer with washers and
R screws. Tighten screws (70) to torque of 25 inch-pounds.

(10) Carefully install assembled packing, seal retainer, and aft seal for fuel control and pump gearshaft, using 289802-3 pilot. Secure seal retainer with screws and
R washers. Tighten screws (5) to torque of 25 inch-pounds.

F. Install External Components (See Figure 201)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Install mount assembly and secure with bolts and washers. Tighten bolts (130) to torque of 80 inch-pounds.

(2) Install housing support and secure with bolt, washers, and nut. Tighten nut (105) to torque of 60 inch-pounds.

(3) Lightly coat packings for oil jets and oil jet plug with engine lubricating oil (72-00-00, GENERAL - SERVICING, Table 301) and install packing on oil jet plug and oil jets.

(4) Install oil jets and oil jet plug and secure with washers and nuts. Tighten nuts (40, 45, 70) to torque of 30 inch-pounds.

(5) Lightly coat packings for chip detector adapter with engine lubricating oil (72-00-00, GENERAL - SERVICING, Table 301) and install packings on adapter.

(6) Install chip detector adapter and secure with nut and washer. Tighten nut (15) to torque of 30 inch-pounds.

R 1. F. (6a) Install oil filter bypass indicator valve installation
R in accordance with 79-30-01, MAINTENANCE PRACTICES.

(7) Install oil filter and cover components in accordance with 79-20-01, MAINTENANCE PRACTICES.

(8) Install breather pressurizing valve with attached seal and packing in accordance with 79-20-02, MAINTENANCE PRACTICES.

2. Inspection/Check

A. Check Accessory Drive Gearbox Assembly Components

(1) Inspect splines of accessory drive gearbox shafts as follows.

(a) Clean splines of accessory drive gearbox shafts in accordance with 3, Cleaning/Painting.

(b) Inspect splines on accessory drive gearbox for wear. Maximum allowable depth of internal spline wear, measured at pitch line of tooth, is a nominal 0.010 inch. Determine wear depth by comparing maximum wear area on spline with end where there is no wear. This "no wear" area is normally at extreme aft end of spline where there is no engagement with mating spline of accessory. If allowable wear limit is exceeded, replace gearshafts as necessary.

(2) Check all gear teeth for evidence of excessive wear. Gear teeth wear shall not exceed ten percent.

(3) Check bearings in accordance with 70-00-00, 7, Bearing Handling and Inspection.

(4) Check threaded parts for stripped, galled, or crossed threads. Replace part if damaged.

(5) Visually check all parts for cracks. No cracks are permitted.

(6) Visually check all parts for evidence of overheating discoloration. Replace part if discoloration is present.

R (7) Visually inspect Diameters A through E illustrated on
R Figures 206 and 207 on accessory gearbox cover (figure
R 202) and housing assembly (figure 203). If wear or
R damage is evident, inspect diameters dimensionally as specified on Figures 206 and 207.

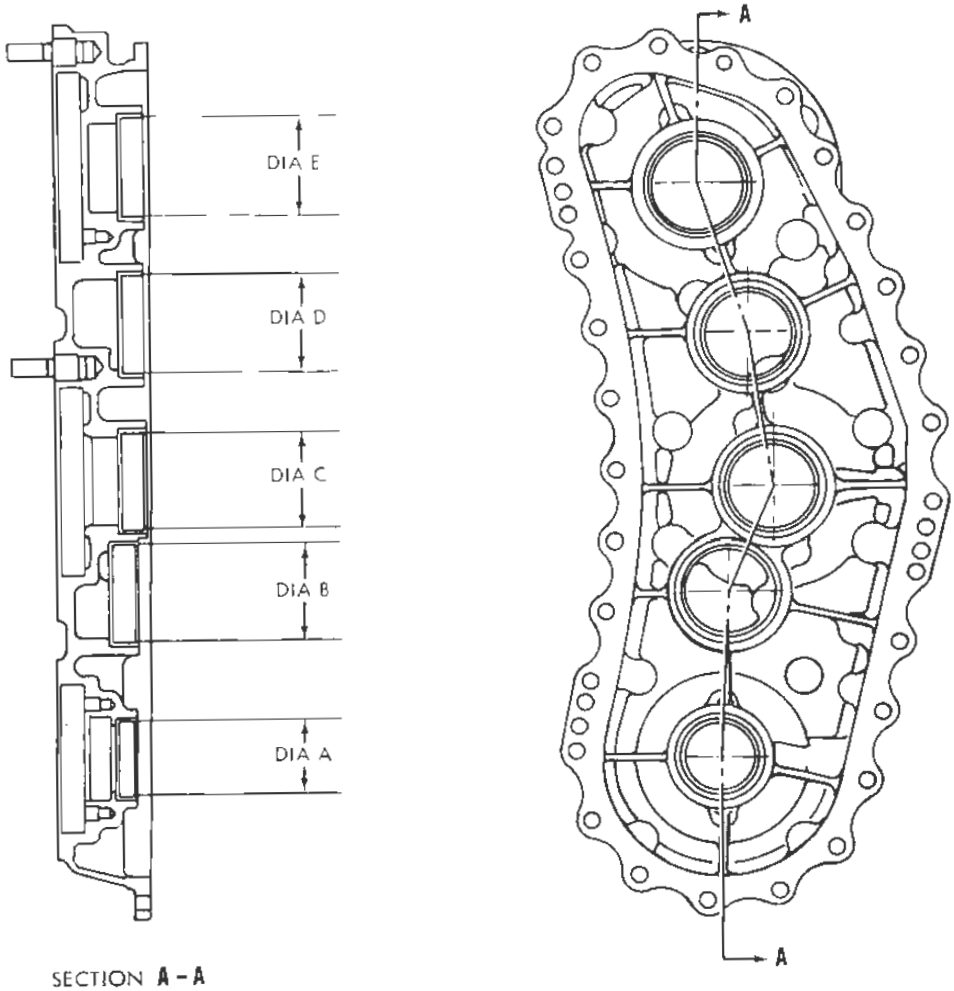
(8) Replace any parts not meeting inspection requirements of steps (1) through (7).

(9) Visually inspect pressed-in filter element support (in bore for oil filter element components) for looseness, scratches, nicks, or cracks. Refer to 4, Approved Repairs if damage is evident.

(10) Visually check accessory drive housing assembly and accessory gearbox cover for damaged paint and corrosion.

Refer to 3, Cleaning/Painting for touchup of damaged paint where no corrosion is evident. Refer to 4, Approved Repairs for repair of corrosion damage.

2. A. (11) Refer to 79-30-01, MAINTENANCE PRACTICES, for inspection instructions for oil filter bypass indicator valve.

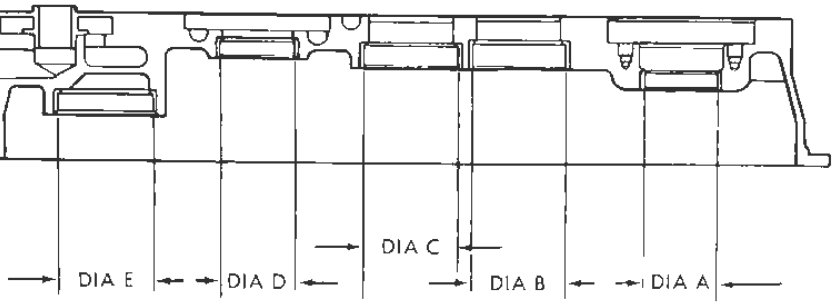


SECTION **A-A**

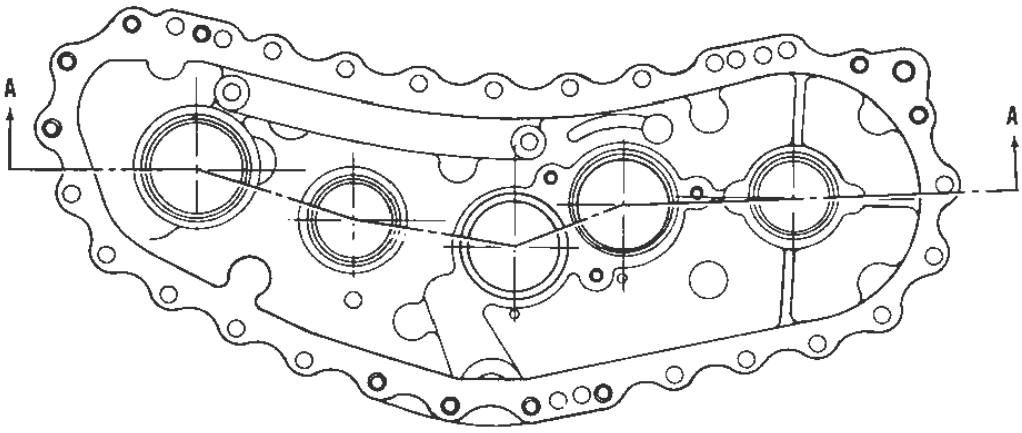
A	B	C	D	E
1.6536 TO 1.6540 IN.	2.1655 TO 2.1659 IN.	2.1655 TO 2.1659 IN.	2.1655 TO 2.1659 IN.	2.1655 TO 2.1659 IN.

1-48A-291

Accessory Gearbox Cover
Figure 206



SECTION A–A



A	B	C	D	E
1.6536 TO 1.6540 IN.	2.1655 TO 2.1659 IN.	2.1655 TO 2.1659 IN.	1.653o TO 1.6540 IN.	2.1655 TO 2.1659 IN.

1-48A-290

Accessory Drive Housing Assembly
Figure 207

3. Cleaning/Painting

Table 203. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Abrasive paper (Federal Specification P-P-101)	Commercially available
R Color coat (A423-66 Enamel R No. 051 and C1178 Converter) R	Griggs Paint, Subsidiary of Domcom Dist, 3602 S 16th Place, Phoenix, AZ 85040
R Primer (P-415-66-611B R and Catalyst C1178-66) R	Griggs Paint, Subsidiary of Domcom Dist, 3602 S 16th Place, Phoenix, AZ 85040

A. Clean Parts

CAUTION: METHANOL (METHYL OR WOOD ALCOHOL) SHALL NOT BE USED AS A CLEANING AGENT WHEN CLEANING MAGNESIUM ACCESSORY DRIVE GEARBOX HOUSING AND ACCESSORY GEARBOX COVER. PROLONGED CONTACT OF METHANOL WITH UNPROTECTED MAGNESIUM COMPONENT WILL DESTROY COMPONENT. USE OF METHANOL WITH MAGNESIUM COMPONENTS IS AUTHORIZED ONLY AS SPECIFICALLY INSTRUCTED FOR REPAIR OF CORRODED SURFACES.

(1) Clean parts as specified in Table 204 in accordance with Cleaning Methods provided in 72-00-00, GENERAL - CLEANING/PAINTING.

(2) Clean all bearings in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, paragraph 1.D.

Table 204. Cleaning Methods

	Figure No.	Item No.	Nomenclature	Cleaning Methods 1	2	3	4	5	6	7	8	9	10	11	12
	All standard metallic hardware			X	X										
	201	5	Oil Drain Plug	X	X			X	X						
		25	Chip Detector Adapter	X	X							X			X
		55	Oil Jet	X	X							X			X
		80	Oil Jet Plug	X	X			X	X						
		90	Oil Jet	X	X			X	X						X
		125	Housing Support	X									X		
		140	Mount Assy	X									X		
R	202	15,80,	Seal Retainer	X	X			X	X						
R		105,													
R		130													
R		30	Accessory Gearbox Cover	X	X					X	X				
	203	40,60 85,105, 150	Gearshaft	X	X							X			
R		130	Air-Oil Separator	X	X			X	X						
R		175	Accessory Drive Housing Assy	X	X					X	X				

3. B. Touch Up Non-Corroded Damaged Painted Surfaces of Accessory Drive Housing Assembly and Accessory Gearbox Cover

(1) Treat any exposed base metal (magnesium) in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method No. 7.

R (2) Touch up bare metal on surfaces with wipe coat of primer (P-415-66-611B and Catalyst C1178-66) as follows.

(a) Prepare primer by mixing in equal parts by volume. Allow mixed primer to stand for 30 minutes before application.

(b) Apply primer, then wipe primer while wet to prevent buildup.

3. B. (2) (c) Air-dry primer for 15 to 30 minutes, then heat-cure with portable hot air gun for one hour at temperature of 80 to 107C (175 to 225F).

(3) Touch up bare metal on surfaces with full coat of
R primer (P-415-66-611B and Catalyst C1178-66) as follows.

(a) Prepare primer by mixing in equal parts by volume. Allow mixed primer to stand for 30 minutes before application.

(b) Apply one coat of primer by brushing or spraying.

(c) Air-dry primer for 15 to 30 minutes, then heat-cure with portable hot air gun for one hour at temperature of 80 to 107C (175 to 225F).

R (4) Touch up damaged color coat (A423-66 Enamel No. 051 and
R C1178 Catalyst) as follows.

(a) Remove damaged paint and blend edges of damaged paint areas with abrasive paper (Federal Specification P-P-101).

(b) Treat any exposed base metal (magnesium) in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method No. 7.

(c) Apply primer as specified in step (3) to a thickness of one mil.

R (d) Prepare color coat by mixing A423-66 Enamel No.
R 051 and C1178 Catalyst in equal parts by volume. Allow mixed color coat to stand for 30 minutes before application.

(e) Apply one coat of color coat two to three mils thick by either brushing or spraying.

(f) Air-dry color coat for 15 to 30 minutes, then heat-cure with portable hot air gun for one hour at temperature of 80 to 107C (175 to 225F).

4. Approved Repairs

Table 205. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
R Color coat (A423-66 Enamel R No. 051 and C1178 Catalyst) R	Griggs Paint, Subsidiary of Domcom Dist, 3602 S 16th Place, Phoenix, AZ 85040
Methanol (methyl or wood alcohol)	Commercially available
R Primer (P-415-66-611B R and Catalyst C1178-66) R	Griggs Paint, Subsidiary of Domcom Dist, 3602 S 16th Place, Phoenix, AZ 85040
Protective coating (Clear Coat V92VC10)	Sherwin-Williams Co, Main Store 2312 N 16th St, Phoenix, AZ 85006
Sandpaper (210 grit size)	Commercially available
Solvent, Stoddard (Federal Specification P-D-680, Type I)	Commercially available
*Touch-up solution (Dow 1)	Dow Corning Corp, S Saginaw Rd, Midland, MI 48640
**Touch-up solution (Dow 19)	Dow Corning Corp, S Saginaw Rd, Midland, MI 48640

NOTE: *Touch-up solution (Dow 1) may be mixed from commercially available chemicals (sodium dichromate and nitric acid) as described in repair procedures.

**Touch-up solution (Dow 19) may be mixed from commercially available chemicals (chromic acid flake and calcium sulfate) as described in repair procedures.

4. A. Repair Corrosion Damaged Areas on Accessory Drive Housing Assembly and Accessory Gearbox Cover

WARNING: METHANOL IS TOXIC AND FLAMMABLE. USE IN WELL-VENTILATED AREA. AVOID BREATHING FUMES OR LONG CONTACT WITH SKIN TO PREVENT DAMAGE TO PHYSICAL HEALTH. KEEP AWAY FROM FLAME TO AVOID FIRE HAZARD.

NOTE: Do not dilute methanol with water or use water (including distilled water) to wash any exposed base metal. Water will cause spreading of corrosion.

(1) Mechanically remove all corrosion by gently wire brushing or sanding. Clean exposed base metal and surrounding area by flushing or swabbing with methanol to remove all traces of dirt, oil, and foreign elements, and to drive out any residual moisture.

(2) Dry all areas to be treated with portable hot air gun for five minutes. Do not allow temperature of surface being repaired to exceed 177C (350F) to prevent scorching any surrounding painted surfaces.

(3) Obtain one gallon of touch-up solution (Dow 1). If desired, touch-up solution may be mixed from commercially available chemicals as follows.

(a) Mix 1.5 pounds of sodium dichromate and 1.5 pints of nitric acid with enough demineralized or distilled water to make one gallon of solution.

(b) Stir solution vigorously for 15 minutes, then allow solution to stand for one to two minutes before use.

CAUTION: TOUCH-UP SOLUTION (DOW 1) SHALL NOT BE ALLOWED TO CONTACT ANODIZED SURFACES. A RAPID DETERIORATION OF THE COATING WILL OCCUR.

(4) Apply touch-up solution (Dow 1) to exposed base metal using an acid resistant brush.

(5) Rinse areas with methanol and blot dry. Thoroughly dry areas with portable hot air gun for five minutes, holding temperature of surface being repaired to a maximum of 177C (350F).

4. A. (6) Obtain one gallon of touch-up solution (Dow 19). If desired, touch-up solution may be mixed from commercially available chemicals as follows.

(a) Mix 1.3 ounces of chromic acid flake and one ounce of calcium sulfate with enough demineralized or distilled water to make one gallon of solution.

(b) Stir solution vigorously for 15 minutes before use.

(7) Swab treated area with touch-up solution (Dow 19). Five minutes after application, wipe off excess solution.

(8) Apply protective coating (Clear Coat V92VC10) to treated areas using fine-bristled brush or paint sprayer. Overlap adjacent mating parts by a minimum of 0.20 inch. After application, heat-cure protective coating for approximately 30 minutes at approximately 149C (300F) using portable hot air gun.

R R (9) When repair area is on surface with a wipe-coat of primer only, reapply primer (P-451-66-611B and Catalyst C1178-66) as follows.

(a) Prepare primer by mixing primer in equal parts by volume. Allow mixed primer to stand for 30 minutes before application.

(b) Apply one coat of primer, then wipe surface while wet to prevent buildup.

(c) Heat-cure primer for 30 minutes with portable hot air gun at temperature of 135 to 149C (275 to 300F).

R (10) When repair area is on surface with color coat, reapply color coat (A423-66 Enamel No. 051 and C1178 Catalyst) as follows.

(a) Prepare primer as specified in step (9)(a).

(b) Apply one coat of primer one mil thick by brushing or spraying.

(c) Heat-cure primer for 30 minutes with portable hot air gun at temperature of 135 to 149C (275 to 300F).

R R (d) Prepare color coat by mixing A423-66 Enamel No. 051 and C1178 Catalyst in equal parts by volume.

Allow mixed color coat to stand for 30 minutes before application.

4. A. (10) (e) Apply one coat of color coat two to three mils thick by either brushing or spraying.

(f) Heat-cure color coat for 30 minutes with portable hot air gun at temperature of 79 to 107C (175 to 225F).

B. Repair or Replace Pressed-In Oil Filter Element Support.
R (See Figure 203)

(1) Blend minor surface damage with abrasive cloth and oil. Mask parts as required during blending to ensure no contamination is allowed to enter oil ports of housing. Ensure all contamination caused by blending is completely removed after repair.

(2) Remove and replace filter element support that is loose, cracked, or damaged beyond repair of step (1) as follows.

(a) Soak replacement filter element support in dry ice until ready for installation.

(b) Pull damaged or loose filter element support from housing.

(c) Thoroughly clean replacement filter element support and mating bore in housing with solvent, Stoddard (Federal Specification P-D-680, Type I). Dry parts thoroughly after cleaning.

R (d) Prepare primer (P-415-66-611B and Catalyst C1178-
R 66) as specified in step A.(9)(a).

(e) Heat bore of housing which will accept filter element support with portable hot air gun. Coat OD surfaces of chilled filter element support which will contact housing with primer, then press filter element support into heated bore to full depth while primer is still wet.

(f) Wipe contact points of filter element support and housing with primer to seal dissimilar metals. Air-dry primer for 20 to 30 minutes, then cure with portable hot air gun at temperature of 82 to 135C (180 to 275F) for one hour.

TRANSFER GEARBOX ASSEMBLY - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Special Tools, Fixtures and Equipment

Item No.	Nomenclature	Use	Source/ Part No.
NOTE: Equivalent substitutes may be used for listed items.			
1.	Shaft Locking Load Simulator	Loads gearshaft for backlash measurement.	289819-1
2.	Backlash Checking Load Simulator	Loads gearshaft for backlash measurement.	289820-1

NOTE: Refer to 72-60-01 for Removal/Installation of transfer gearbox assembly on engine.

A. Disassemble Transfer Gearbox Assembly (See Figures 201 and 202)

NOTE: If any parts other than packings, N2 transducer components, or the upper bearing support illustrated in Figure 202 require replacement, complete transfer gearbox assembly shall be replaced.

(1) Remove N2 transducer in accordance with 77-10-05, MAINTENANCE PRACTICES.

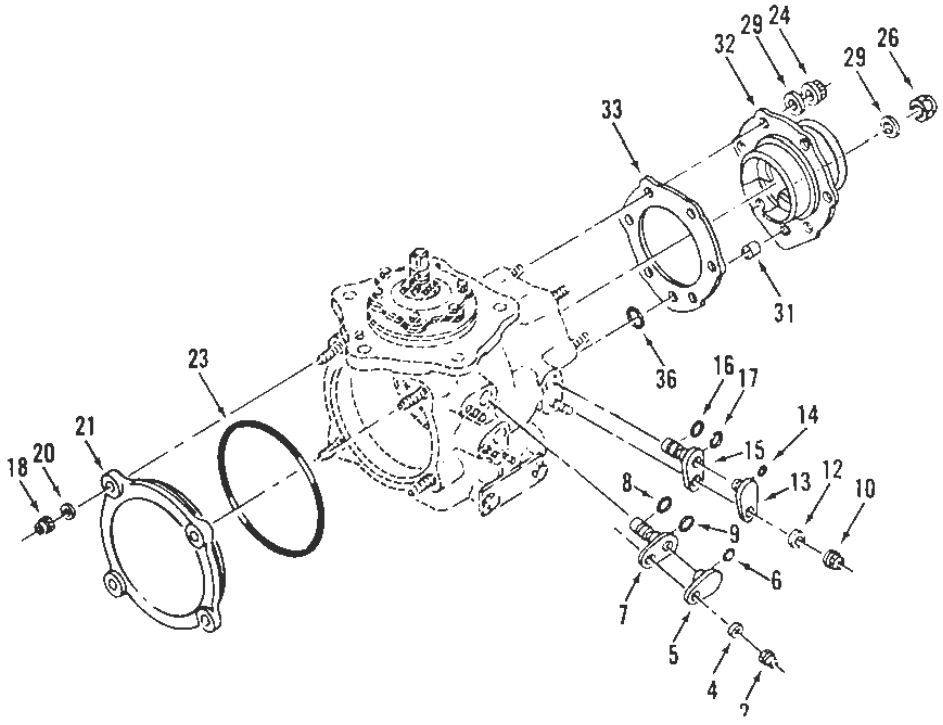
(2) Remove nuts and washers securing transfer gearbox cover, then remove cover and packing.

(3) Remove nut and washer securing aft oil jet components, then remove aft oil jet cleanout plug, oil jet nozzle and packings.

(4) Check backlash of transfer gearbox assembly as follows.

(a) Install 289819-1 load simulator over upper gearshaft with four integral setscrews on load simulator. Tighten load simulator jam nut to load upper gearshaft.

1. A. (4) (b) Install 289820-1 load simulator through bore of forward gearshaft and secure with integral nut on load simulator. Tighten load simulator jam nut to load forward gearshaft.



Transfer Gearbox Assembly
Figure 201

1. A. (4) (c) Using dial indicator, measure backlash at center of gear tooth on forward gearshaft. Make two measurements approximately 180 degrees apart. If either measurement is not 0.004 to 0.007 inch, entire transfer gearbox assembly shall be replaced. If backlash is within specified range, remove 289819-1 and 289820-1 load simulators and continue procedure.

(5) Remove nuts and washers securing forward bearing carrier illustrated in Figure 201. Move forward bearing carrier forward approximately one-fourth inch but do not remove. Push forward gearshaft forward to clear upper bearing support illustrated in Figure 202.

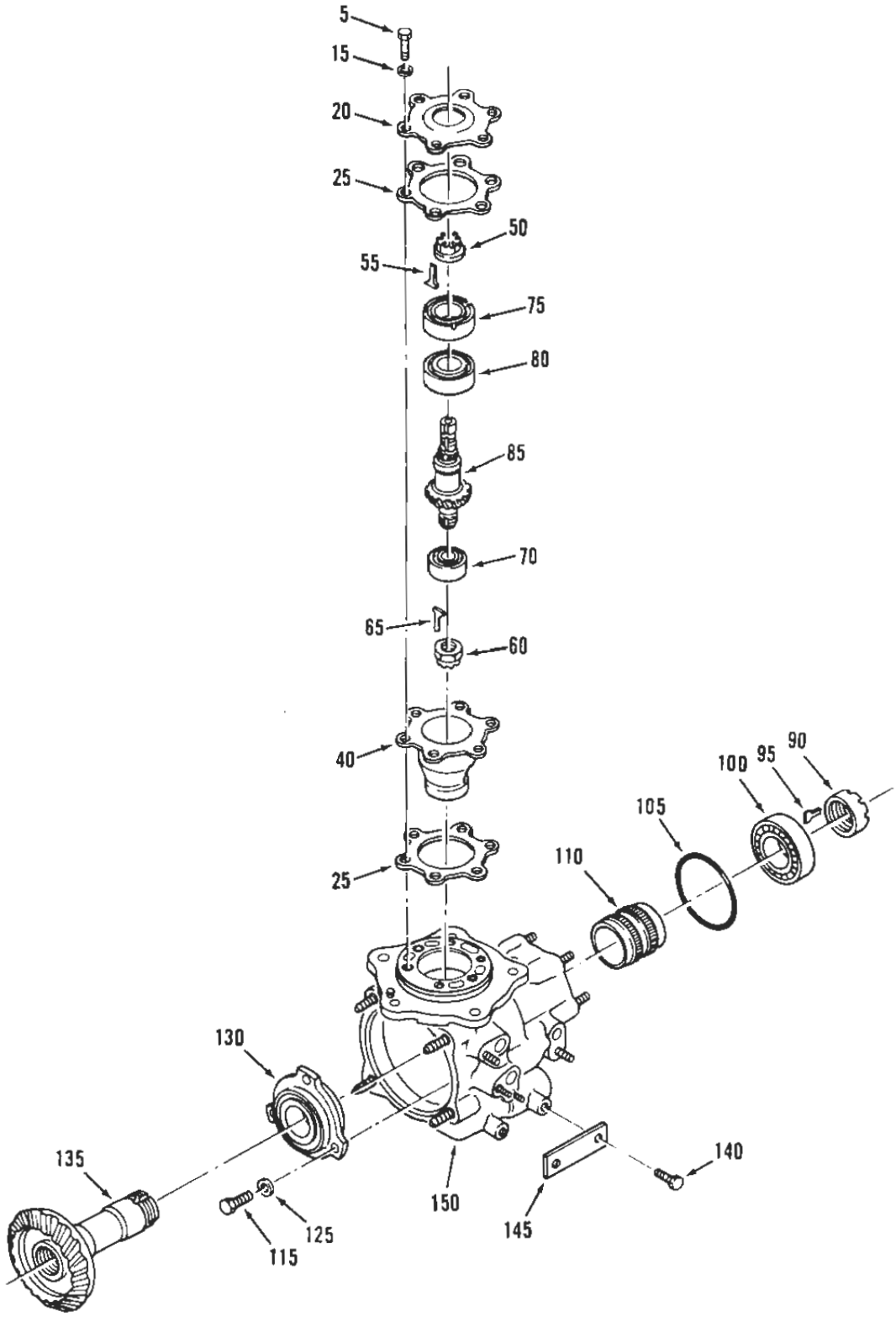
(6) Remove screws and washers securing upper bearing retainers and shims on shoulder of transfer gearbox housing. Remove retainer and shims. Record number and thickness of shims as shim pack Y for use at reassembly.

(7) Remove vertical bevel gearshaft with assembled parts, upper bearing support and shims installed beneath upper bearing support. Note number and thickness of shims as shim pack X for use at reassembly.

KEY TO FIGURE 201

2.	NUT (IPC FIG. 69)	16.	PACKING
4.	WASHER	17.	PACKING
5.	OIL JET CLEANOUT PLUG (AFT)	18.	NUT
6.	PACKING	20.	WASHER
7.	OIL JET NOZZLE (AFT)	21.	TRANSFER GEARBOX COVER
8.	PACKING	23.	PACKING
9.	PACKING	24.	NUT
10.	NUT	26.	NUT
12.	WASHER	29.	WASHER
13.	OIL JET CLEANOUT PLUG (FORWARD)	*31.	TUBE
		*32.	FORWARD BEARING CARRIER
14.	PACKING	*33.	SHIM (CARRIER)
15.	OIL JET NOZZLE (FORWARD)	*36.	PACKING

*NOT REMOVED AT MAINTENANCE LEVEL



Transfer Gearbox Assembly
Figure 202

1. A. (8) Remove vertical bevel gearshaft with assembled parts from upper bearing support with brass drift.

(9) If required to correct oil leaks or for cleaning, remove nut and washer securing forward oil jet components, then remove oil jet cleanout plug, oil jet nozzle and packings.

B. Assemble Transfer Gearbox Assembly (See Figures 201, 202, and 203)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

If new upper bearing support (figure 202) is to be installed, perform steps (1 through 5) to determine new required thickness for shim packs Y and X recorded at disassembly. If same upper bearing support is to be reinstalled, begin assembly with step (3).

(1) Using upper bearing support and upper bearing retainer removed from transfer gearbox, make the following measurements and calculations:

KEY TO FIGURE 202

5.	SCREW (IPC FIG. 70)	85.	BEVEL GEARSHAFT (VERTICAL)
15.	WASHER	* 90.	ROUND PLATE NUT
20.	UPPER BEARING RETAINER	95.	KEY (ROUND PLAIN NUT)
25.	SHIM	*100.	ANNULAR BALL BEARING
40.	UPPER BEARING RETAINER	*105.	PACKING
*50.	SLOTTED HEXAGON NUT (UPPER)	*110.	SPEED PICKUP SPACER
*55.	KEY (UPPER SLOTTED HEXAGON NUT)	*115.	SCREW
*60.	SLOTTED HEXAGON NUT (LOWER)	*125.	WASHER
*65.	KEY (LOWER SLOTTED HEXAGON NUT)	*130.	CYLINDRICAL ROLLER BEARING (REAR)
*70.	CYLINDRICAL ROLLER BEARING (LOWER)	*135.	BEVEL GEARSHAFT (HORIZONTAL)
*75.	THRUST BALL BEARING	*140.	SCREW
*80.	CYLINDRICAL ROLLER BEARING (UPPER)	*145.	NAMEPLATE
		150.	HOUSING ASSY

*NOT REMOVED AT MAINTENANCE LEVEL

1. B. (1) (a) Measure depth of center bearing support shoulder from top of bearing support flange. Record as Dimension A. (See figure 203.)

(b) Measure thickness of bearing support flange and record as Dimension B. (See figure 203.)

(c) Measure height of step on under side of upper bearing retainer used to secure vertical bevel gearshaft assembly, shims and upper bearing support. Record as Dimension D. (See figure 203.)

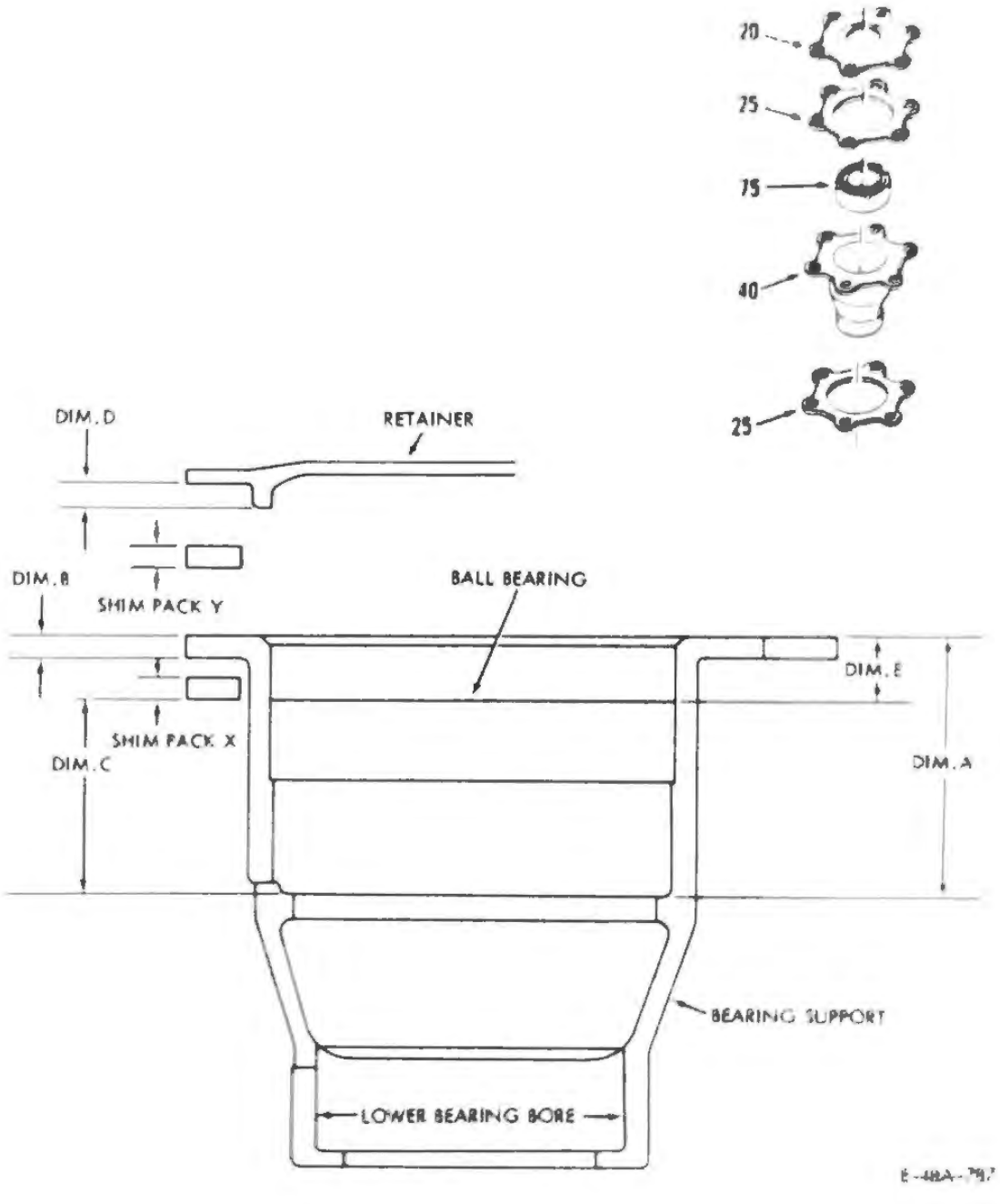
(d) Calculate and record Dimension C using shim pack X thickness recorded at disassembly and Dimensions A and B recorded in steps (a) and (b): (Dimension C=A-(B+X)).

(2) Repeat step (1) using replacement upper bearing support to be installed. If new C dimension is not the same as Dimension C obtained using upper bearing support removed from unit, adjust thickness of shim pack X as required to obtain difference dimension of 0.001 inch or less.

(3) Install upper and lower bearing outer races on vertical bevel gearshaft and assembled parts, then install gearshaft in upper bearing support to be installed on transfer gearbox assembly.

CAUTION: ENSURE THAT CENTER BEARING ON VERTICAL BEVEL GEARSHAFT IS IN CONTACT WITH UPPER BEARING SUPPORT SHOULDER BEFORE PROCEEDING.

(4) Using shim pack X determined in step (2) (replacement upper bearing support to be installed) or as noted at disassembly (original upper bearing support to be installed), install shim pack X and upper bearing support with assembled parts in transfer gearbox housing.



R

R 20. RETAINER (IPC FIG. 70)
R 25. SHIM
40. BEARING SUPPORT
75. BALL BEARING

Transfer Gearbox Shimming Measurements
Figure 203

NOTE: If original upper bearing support is to be re-installed, ensure bore for lower bearing is dimensionally inspected prior to reassembly in accordance with 2, Inspection/Check.

1. B. (5) If original upper bearing support is installed, assemble shim pack Y thickness recorded at disassembly. If replacement upper bearing support is installed, calculate required thickness for shim pack Y as follows.

(a) Measure depth of outer race on upper bearing of vertical bevel gearshaft. Record depth as Dimension E.

(b) Compare Dimension A recorded in step (1) (on original upper bearing support) with Dimension A recorded in step (2) (on replacement upper bearing support). If Dimension A is greater on replacement part, reduce shim pack Y thick-ness by amount of difference dimension. If Dimension A is less on replacement part, increase shim pack Y thickness by amount of difference dimension. Record thickness of shim pack Y to be used.

(c) Check for correct shim thickness using Dimension D for replacement part recorded in step (2), Dimension E recorded in step (5)(a) and Dimension Y determined in step (5)(b) using the following formula: $E-D+Y=0.002\pm0.002$ inch. If within tolerance, calculation assures a loose fit of 0.000 to 0.004 inch between Dimensions D and E.

(d) Install shim pack Y thickness determined in steps (b) and (c).

(6) Install upper bearing retainer over vertical bevel gearshaft and secure to shoulder of transfer gearbox housing with screws and washers. Tighten screws (5, figure 202) to torque of 40 inch-pounds.

(7) Push horizontal bevel gearshaft into place to engage vertical bevel gearshaft. Push forward bearing carrier (32, figure 201) against transfer gearbox housing and secure with nuts and washers. Tighten nuts (24, 26) to torque of 30 inch-pounds.

(8) Check for required backlash by performing step 1.A.(4). If backlash is not as specified, transfer gearbox assemby shall be replaced.

D R 1. B. (9) Install new packings on aft oil jet nozzle and oil jet cleanout plug. Install aft oil jet nozzle and oil jet cleanout plug, then secure with nut and washer. Tighten nut (2) to torque of 30 inch-pounds.

(10) If removed at disassembly, install new packings on forward oil jet nozzle and oil jet cleanout plug. Install forward oil jet nozzle and oil jet cleanout plug, then secure with nut and washer. Tighten nut (10) to torque of 30 inch-pounds.

(11) If transfer gearbox assembly is to be reinstalled on engine, install in accordance with 72-60-01, MAINTENANCE PRACTICES. If transfer gearbox assembly is to be stored or shipped, assemble transfer gearbox cover with new packing and secure with nuts and washers. Tighten nuts (18) to torque of 10 inch-pounds.

(12) Install N2 transducer in accordance with 77-10-05, MAINTENANCE PRACTICES.

2. Inspection/Check

R A. Inspect Transfer Gearbox Assembly Components

R (1) Inspect threaded parts for stripped, galled, or crossed threads. Replace part if damaged.

R (2) Inspect parts for cracks. No cracks are permitted.

R (3) Inspect parts for evidence of overheating discoloration. Replace part if discoloration is evident.

R (4) Inspect teeth for evidence of abnormal or deep wear patterns.

(5) Dimensionally check diameter for lower bearing on lower bearing support (when disassembly allows) for diameter of 1.101 inches maximum.

R (6) Inspect all bearings in accordance with 70-00-00, 7, Bearing Handling and Inspection.

R (7) Inspect speed pick-up spacer as follows.

R R NOTE: Minor surface scratches, nicks, or marks are acceptable.

R R (a) Inspect spacer for evidence of excessive damage due to contact with N2 transducer.

R 2. A. (7) (b) Inspect spacer for cracks, broken, or chipped
R teeth.

(8) Replace parts that do not meet inspection requirements of steps (1) through (7). Components other than packings, N2 transducer components, or upper bearing support, require complete transfer gearbox assembly replacement.

R (9) Inspect transfer gearbox housing assembly for damaged paint and corrosion. Refer to 3, Cleaning/Painting for touchup of damaged paint where no corrosion is evident. Refer to 4, Approved Repairs for repair of corrosion damage.

3. Cleaning/Painting

Table 202. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Abrasive paper (Federal Specification P-P-101)	Commercially available
R Color coat (A423-66 Enamel R No. 051 and C1178 Catalyst) R	Griggs Paint, Subsidiary of Domcom Dist, 3602 S 16th Place, Phoenix, AZ 85040
R Primer (P-415-66-611B R and Catalyst C1178-66) R	Griggs Paint, Subsidiary of Domcom Dist, 3602 S 16th Place, Phoenix, AZ 85040

3. A. Clean Parts

CAUTION: METHANOL (METHYL OR WOOD ALCOHOL) SHALL NOT BE USED AS A CLEANING AGENT WHEN CLEANING MAGNESIUM HOUSING ASSEMBLY OF TRANSFER GEARBOX. PROLONGED CONTACT OF METHANOL WITH UNPROTECTED MAGNESIUM COMPONENT WILL DESTROY COMPONENT. USE OF METHANOL WITH MAGNESIUM COMPONENTS IS AUTHORIZED ONLY AS SPECIFICALLY INSTRUCTED FOR REPAIR OF CORRODED SURFACES.

(1) Clean parts as specified in Table 203 in accordance with cleaning methods specified in 72-00-00, GENERAL - CLEANING/PAINTING.

(2) Clean bearings in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, paragraph 1.D.

Table 203. Cleaning Methods

Figure No.	Item No.	Nomenclature	Cleaning Methods 1	2	3	4	5	6	7	8	9	10	11	12
All standard metallic hardware			X	X										
201	5	Oil Jet Cleanout Plug	X	X										
	7	Oil Jet Nozzle												X
	13	Oil Jet Cleanout Plug	X	X										
	15	Oil Jet Nozzle												X
	21	Transfer Gearbox Cover	X	X										
202	20	Bearing Retainer	X	X										
	25	Shim	X	X										

3. B. Touch up Non-Corroded Damaged Painted Surfaces of Transfer Gearbox Housing

(1) Treat any exposed base metal (magnesium) in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method No. 7.

(2) Touch up bare metal on surfaces with wipe coat of
R primer (P415-66-611B and Catalyst C1178-66) as follows.

R (a) Prepare primer by mixing in equal parts by volume. Allow mixed primer to stand for 30 minutes before application.

(b) Apply primer, then wipe primer while wet to prevent buildup.

(c) Air-dry primer for 15 to 30 minutes, then heat-cure with portable hot air gun for one hour at temperature of 80 to 107C (175 to 225F).

(3) Touch up bare metal on surfaces with full coat of
R primer (P-415-66-611B and Catalyst C1178-66) as follows.

R (a) Prepare primer by mixing in equal parts by volume. Allow mixed primer to stand for 30 minutes before application.

3. B. (3) (b) Apply one coat of primer by brushing or spraying.

(c) Air-dry primer for 15 to 30 minutes, then heat-cure with portable hot air gun for one hour at temperature of 80 to 107C (175 to 225F).

R R (4) Touch up damaged color coat (A423-66 Enamel No. 051 and C1178 Catalyst) as follows.

(a) Remove damaged paint and blend edges of damaged paint areas with abrasive paper (Federal Specification P-P-101).

(b) Treat any exposed base metal (magnesium) in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method No. 7.

(c) Apply primer as specified in step (3) to a thickness on one mil.

R R (d) Prepare color coat by mixing A423-66 Enamel No. 051 and C1178 Catalyst in equal parts by volume. Allow mixed color coat to stand for 30 minutes before application.

(e) Apply one coat of color coat two to three mils thick by either brushing or spraying.

(f) Air-dry color coat for 15 to 30 minutes, then heat-cure with portable hot air gun for one hour at temperature of 80 to 107C (175 to 225F).

4. Approved Repairs

Table 204. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
R Color coat (A423-66 Enamel R No. 051 and C1178 Catalyst) R	Griggs Paint, Subsidiary of Domcom Dist, 3602 S 16th Place, Phoenix, AZ 85040
Methanol (methyl or wood alcohol)	Commercially available
R Primer (P-415-66-611B R and Catalyst C1178-66) R	Griggs Paint, Subsidiary of Domcom Dist, 3602 S 16th Place, Phoenix, AZ 85040
Protective coating (Clear Coat V92VC10)	Sherwin-Williams Co, Main Store, 2312 N 16th St, Phoenix AZ 85006
Sandpaper (210 grit size)	Commercially available
*Touch-up solution (Dow 1)	Dow Corning Corp, S Saginaw Rd, Midland, MI 48640
**Touch-up solution (Dow 19)	Dow Corning Corp, S Saginaw Rd, Midland, MI 48640

NOTE: *Touch-up solution (Dow 1) may be mixed from commercially available chemicals (sodium dichromate and nitric acid) as described in repair procedures.

**Touch-up solution (Dow 19) may be mixed from commercially available chemicals (chromic acid flake and calcium sulfate) as described in repair procedures.

4. A. Repair Corrosion Damaged Areas on Gearbox Housing

WARNING: METHANOL IS TOXIC AND FLAMMABLE. USE IN WELL-VENTILATED AREA. AVOID BREATHING FUMES OR LONG CONTACT WITH SKIN TO PREVENT DAMAGE TO PHYSICAL HEALTH. KEEP AWAY FROM FLAME TO AVOID FIRE HAZARD.

NOTE: Do not dilute methanol with water or use water (including distilled water) to wash any exposed base metal. Water will cause spreading of corrosion.

(1) Mechanically remove all corrosion by gently wire brushing or sanding. Clean exposed base metal and surrounding area by flushing or swabbing with methanol to remove all traces of dirt, oil, and foreign elements, and to drive out any residual moisture.

(2) Dry all areas to be treated with portable hot air gun for five minutes. Do not allow temperature of surface being repaired to exceed 177C (350F) to prevent scorching any surrounding painted surfaces.

(3) Obtain one gallon of touch-up solution (Dow 1). If desired, touch-up solution may be mixed from commercially available chemicals as follows.

(a) Mix 1.5 pounds of sodium dichromate and 1.5 pints of nitric acid with enough demineralized water to make one gallon of solution.

(b) Stir solution vigorously for 15 minutes, then allow solution to stand for one to two minutes before use.

CAUTION: TOUCH-UP SOLUTION (DOW 1) SHALL NOT BE ALLOWED TO CONTACT ANODIZED SURFACES. A RAPID DETERIORATION OF THE COATING WILL OCCUR.

(4) Apply touch-up solution (Dow 1) to exposed base metal using an acid resistant brush.

(5) Rinse areas with methanol and blot dry. Thoroughly dry areas with portable hot air gun for five minutes, holding temperature of surface being repaired to a maximum of 177C (350F).

(6) Obtain one gallon of touch-up solution (Dow 19). If desired, touch-up solution may be mixed from commercially available chemicals as follows.

4. A. (6) (a) Mix 1.3 ounces of chromic acid flake and one ounce of calcium sulfate with enough demineralized or distilled water to make one gallon of solution.

(b) Stir solution vigorously for 15 minutes before use.

(7) Swab treated area with touch-up solution (Dow 19). Five minutes after application, wipe off excess solution.

(8) Apply protective coating (Clear Coat V92VC10) to treated areas using fine-bristled brush or paint sprayer. Overlap adjacent mating parts by a minimum of 0.20 inch. After application, heat-cure protective coating for approximately 30 minutes at approximately 149C (300F) using portable hot air gun.

(9) When repair area is on surface with a wipe-coat of primer only, reapply primer (P-415-66-611B and Catalyst C1178-66) as follows.

(a) Prepare primer by mixing in equal parts by volume. Allow mixed primer to stand for 30 minutes before application.

(b) Apply one coat of primer, then wipe surface while wet to prevent buildup.

(c) Heat-cure primer for 30 minutes with portable hot air gun at temperature of 135 to 149C (275 to 300F).

(10) When repair area is on surface with color coat, reapply color coat (A423-66 Enamel No. 051 Enamel and C1178 Catalyst) as follows.

(a) Prepare primer as specified in step (9)(a).

(b) Apply one coat of primer one mil thick by brushing or spraying.

(c) Heat-cure primer for 30 minutes with portable hot air gun at temperature of 135 to 149C (275 to 300F).

(d) Prepare color coat by mixing A423-66 Enamel No. 051 and C1178 Catalyst in equal parts by volume. Allow mixed color coat to stand for 30 minutes before application.

4. A. (10) (e) Apply one coat of color coat two or three mils thick by either brushing or spraying.

(f) Heat-cure color coat for 30 minutes with portable hot air gun at temperature of 79 to 107C (175 to 225F).

CHAPTER 72 - BY-PASS SECTION

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BY-PASS SECTION - DESCRIPTION AND OPERATION

1. General

The by-pass section of the engine consists essentially of those components located at the front of the engine and encloses the air inlet section. The principal components of the by-pass section are the fan spinner, fan spinner support, fan rotor assembly, fan by-pass stator, fan support and shaft section, planet gear assembly (by-pass fan reduction gear section), and the outer fan duct assembly or set. The by-pass fan assembly is driven through a planet gear and ring gear assembly by the low pressure compressor and turbine assembly. The by-pass fan is supported by a forward roller bearing and a rear ball bearing with a forward carbon seal to prevent oil leakage into air cavity behind the fan.

Inlet air through the fan is routed into the compressor section and through the by-pass components. The majority of by-pass fan air is used as direct thrust.

R FAN SPINNER AND SPINNER SUPPORT
INSTALLATION - MAINTENANCE PRACTICES

R 1. Removal/Installation

R Table 201. Materials and Compounds
R

Material or Compound	Manufacturer
CAUTION: ANY SUBSTITUTES USED FOR LISTED INDUSTRIAL MARKING INK OR YELLOW CHINA MARKER SHALL CONTAIN NO CARBON.	
NOTE: Equivalent substitutes may be used for listed items.	
Industrial marking ink (Violet, No. 127-1/2)	Pannier Corp, 207 Sandusky St, Pittsburgh, PA 15212
Lubricating compound (Liqui-Moly, Grade NV, thread compound)	Lockrey Co, Lubricants Div, Cedar Shores, Southampton, NY 11968
Yellow china marker (No. 170T)	Blaisdell Pencil Co, Philmont Rd, Bethagres, PA 19006

R Table 202. Special Tools, Fixtures and Equipment
R

Item No.	Nomenclature	Use	Source/ Part No.
NOTE: Equivalent substitutes may be used for listed item.			
1.	Spinner Support Mechanical Puller	Remove spinner support.	291265-1

R CAUTION: (CODES A, B POST SB72-3085) FAN SPINNER PART
R NO. 3072867-1 OR 3072867-2 IS MANUFACTURED OF
R ALUMINUM ALLOY AND CARE SHOULD BE USED IN HAN-
R DLING TO PREVENT DAMAGE TO SPINNER.

R WHEN REMOVING AND/OR INSTALLING SPINNER UTIL-
R IZING BUSHINGS ENSURE ALL BUSHINGS REMOVED ARE
R REINSTALLED. IT IS CRITICAL THAT FAN INLET
R HOUSING BE FREE OF FOREIGN MATERIAL.

R NOTE: Fan rotor assembly, spinner support, and fan
R spinner are balanced components. Index compo-
R nents prior to disassembly to prevent possible
R vibration problem upon reassembly.

R 1. A. Remove Fan Spinner (See Figure 201)

R (1) Index fan spinner to spinner support with industrial
R marking ink (Violet, No. 127-1/2) or yellow china
R marker (No. 170T).

R (2) Remove bolts securing fan spinner to engine.

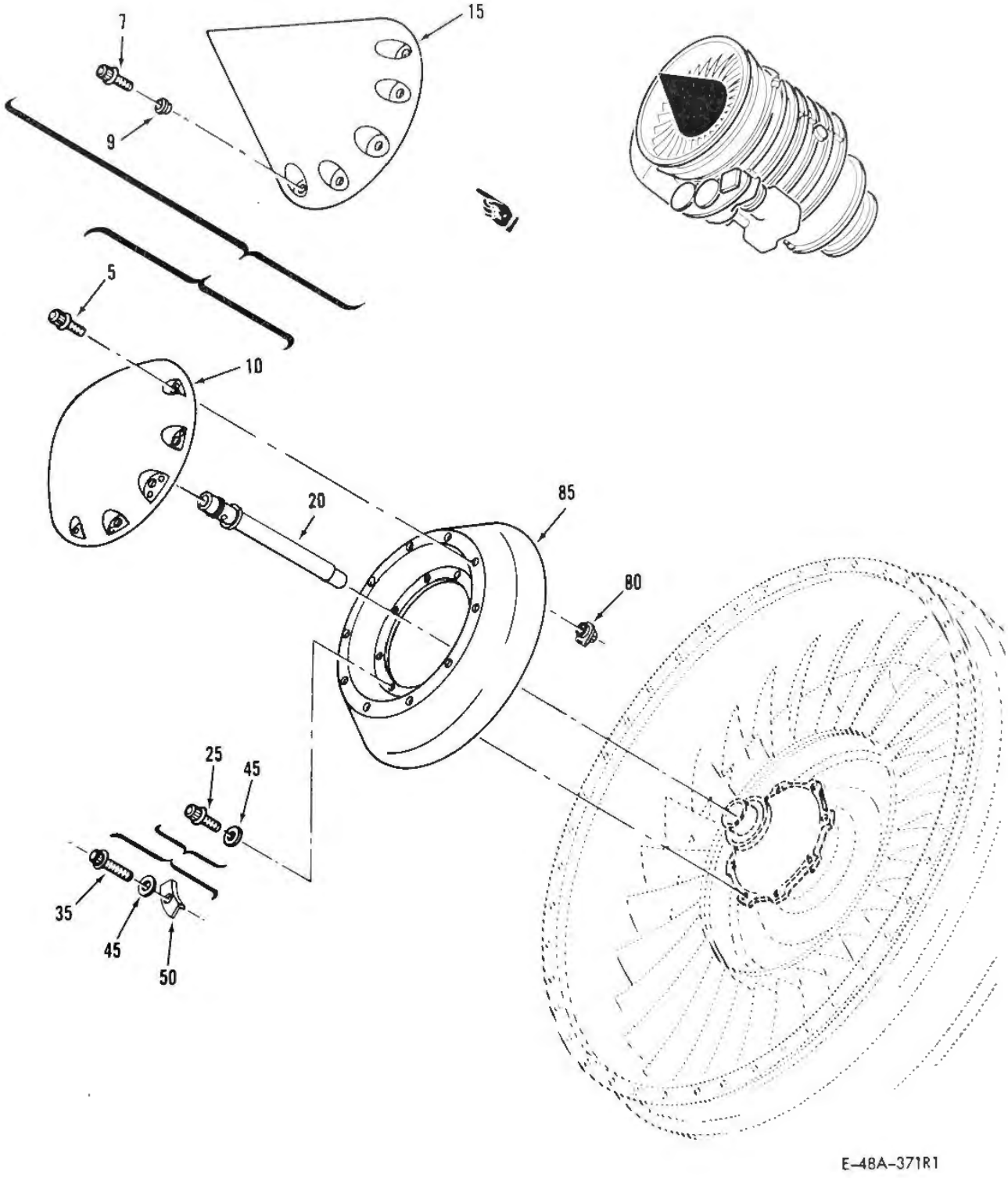
R (3) (Code C) (Codes A, B Pre SB72-3085) Remove fan spinner
R and anti-ice tube.

R (4) (Codes A, B Post SB72-3085) Remove fan spinner and, if
R applicable, bushings.

R KEY TO FIGURE 201

R 5.	BOLT (IPC FIG. 74)	*20.	ANTI-ICE TUBE (CODE C) (CODES A, B PRE SB72-3085)
R ** 7.	BOLT (CODES A, B POST SB72-3085)	25.	BOLT
R ** 9.	BUSHING (CODES A, B POST SB72-3085)	35.	BOLT
R *10.	FAN SPINNER (CODE C) (CODES A, B PRE SB72-3085)	45.	WASHER
		50.	WEIGHT
R **15.	FAN SPINNER (CODES A, B POST SB72-3085)	80.	NUT
		85.	SPINNER SUPPORT

R *(CODE C) (CODES A, B PRE SB72-3085)
R **(CODES A, B POST SB72-3085)



R Fan Spinner and Spinner Support Installation
R Figure 201

R 1. B. Install Fan Spinner (See Figure 201)

R CAUTION: (CODES A, B POST SB72-3085) FAN SPINNER
R PART NO. 3072867-1 OR 3072867-2 IS MANU-
R FACTURED OF ALUMINUM ALLOY AND CARE SHOULD
R BE USED IN HANDLING TO PREVENT DAMAGE TO
R SPINNER.

R DO NOT APPLY PAINT TO FAN SPINNER.
R CHIPPED PAINT MAY BE DETRIMENTAL, ALLOWING
R ICING TO OCCUR.

R THERE ARE THREE SPINNERS AVAILABLE FOR
R INSTALLATION. ENSURE PROPER BOLTS AND
R BUSHING, IF APPLICABLE, ARE INSTALLED.

R WHEN REMOVING AND/OR INSTALLING SPINNER
R UTILIZING BUSHINGS, ENSURE ALL BUSHINGS
R REMOVED ARE REINSTALLED. IT IS CRITICAL
R THAT FAN INLET HOUSING BE FREE OF FOREIGN
R MATERIAL.

R NOTE: Refer to 70-00-00, STANDARD PRACTICES for
R general torque values. Add frictional drag
R (run-down) torque of self-locking devices to
R recommended values.

R (1) Apply a light coat of lubricating compound (Liqui-Moly,
R Grade NV, thread compound) to bolts.

R (2) (Code C) (Codes A, B Pre SB72-3085) Position anti-ice
R tube in fan shaft assembly with holes toward forward
R end. Align index markings and install fan spinner,
R then secure with bolts. Tighten bolts (5) to torque of
R 60 inch-pounds.

R (3) (Codes A, B Post SB72-3085) Align index markings and
R install fan spinner and bushings, as applicable, and
R secure with bolts. Tighten bolts (7) to torque of 60
R inch-pounds.

R C. Remove Spinner Support (See Figure 201)

R (1) Remove fan spinner in accordance with step 1.A.

R NOTE: If any banace weights are installed, in-
R dex balance weights to fan spinner sup-
R port locations with industrial marking
R ink (Violet, No. 127-1/2) or yellow
R china marker (No. 170T).

R (2) Index spinner support to fan rotor assembly with indus-
R trial marking ink (Violet, No. 127-1/2) or yellow china

R marker (No. 170T). Remove bolts, washers and, if in-
R stalled, balance weights. Remove spinner support using
R 291265-1 puller.

R 1. D. Install Spinner Support (See Figure 201)

R NOTE: Refer to 70-00-00, STANDARD PRACTICES for
R general torque values. Add frictional drag
R (run-down) torque of self-locking devices to
R recommended values.

R (1) Apply a light coat of lubricating compound (Liqui-Moly,
R Grade NV, thread compound) to bolts.

R NOTE: If any balance weights were removed at
R disassembly, reinstall weights at in-
R dexed positions.

R (2) Align index markings and install fan spinner support on
R fan rotor assembly and secure with balance weights (if
R removed), washers, and bolts. Minimum run-down torque
R on bolts (25 or 35) shall be 12 inch-pounds at each
R bolt location. At any bolt location where run-down
R torque is not as specified, replace nuts on fan rotor
R assembly in accordance with 72-70-03, 4, Approved
R Repairs. Tighten bolts (25 or 35) to torque of 60
R inch-pounds.

R (3) Install fan spinner in accordance with paragraph 1.B.

R 2. Inspection/Check

R A. Inspect Fan Spinner (See Figure 201)

R (1) (Code C) (Codes A, B Pre SB72-3085) Inspect for
R distortion, dents, cracked welds, and excessive wear in
R anti-ice tube bore. Distortion, dents, cracked welds,
R or excessive wear in anti-ice tube bore is not
R acceptable.

R (2) (Codes A, B Post SB72-3085) Inspect Fan Spinner Part
R No. 3072825-1 for distortion, dents, or cracks.
R Distortion, dents, or cracks are not acceptable.

R (3) (Codes A, B Post SB72-3085) Inspect Fan Spinner, all
R except Part No. 3072825-1, as follows.

R (a) Inspect tip for damage.

R (b) Inspect cone surface for nicks or scratches.
R Nicks shall not exceed 0.010 inch in depth.
R Scratches shall not exceed 0.010 inch in depth and
R 1.0 inch in length. Adjacent nicks or scratches

R shall be a minimum of 1.0 inch apart. Any number
R of nicks or scratches are acceptable if within
R limits. Refer to 4, Approved Repairs for blending
R of scratches within acceptable limits.

R 2. A. (3) (c) Inspect bolt holes for damage, and if applicable,
R bushings for security.

R (d) Replace part that does not meet inspection
R requirements of steps (a) through (c) and is
R beyond scope of 4, Approved Repairs.

R B. (Code C) (Codes A, B Pre SB72-3085) Inspect Anti-Ice Tube
R (See Figure 201)

R (1) Inspect for distortion or dents causing a crease or
R which reduce diameter more than ten percent.

R (2) Inspect for clogged passageway.

R (3) Inspect for excessive wear or fretting.

R (4) Inspect for signs of oil within tube. Oil in tube in-
R dicates a leak in anti-ice seal or plumbing (72-72-01,
R figure 201) in fan support housing.

R (5) Replace tube if distortion, excessive wear or fretting,
R clogged passageway, or dents causing a crease or which
R reduce diameter more than ten percent are evident.

R C. Inspect Spinner Support (See Figure 201)

R (1) Inspect for cracks, dents, corrosion, or excessive
R fretting at mounting faces.

R (2) Check nuts for security and stripped or damaged
R threads. Check nuts for minimum run-down torque using
R a new bolt. Some radial movement of nut is acceptable.
R Stripped or damaged threads are not acceptable. Run-
R down torque shall be six inch-pounds minimum. If run-
R down torque is less than specified or nut is not ser-
R viceable, replace nut in accordance with 4, Approved
R Repairs.

R (3) Replace spinner support if cracks, dents, corrosion, or
R excessive fretting is evident.

R 3. Cleaning/Painting

R Table 203. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed item.	
Methyl-ethyl-ketone (MEK) (Federal Specification TT-M-261)	Commercially available

R A. Clean Parts (See Figure 201)

R (1) (Code C) (Codes A, B Pre SB72-3085) Clean all standard hardware, fan spinner, and anti-ice tube in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method No. 1 or 2.

R (2) (Codes A, B Post SB72-3085) Clean Fan Spinner Part No. 3027825-1 and all standard hardware in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method No. 1 or 2.

R (3) (Codes A, B Post SB72-3085) Clean Fan Spinner Part No. 3072867-1 or 3072867-2 in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method No. 1 or 2 and 5 or 6.

R (4) Clean spinner support.

R (a) Clean surfaces using methyl-ethyl-ketone (MEK) (Federal Specification TT-M-261).

R (b) Immerse support in alkaline cleaner solution specified in 72-00-00, GENERAL - CLEANING/PAINTING, for two to four minutes and brush as required.

R (c) Rinse support in warm tap water at 27 to 43C (80 to 110F), then dry with clean compressed air.

R 4. Approved Repairs

R Table 204. Special Tools, Fixtures and Equipment
R

R Item No.	Nomenclature	Use	Source/ Part No.
R NOTE: Equivalent substitutes may be used for listed item.			
R 1.	Nutplate Wrench Set	Used to install nut on fan spinner support.	293328-1

R Table 205. Materials and Compounds
R

R Material or Compound	Manufacturer
R NOTE: Equivalent substitutes may be used for listed items.	
R Adhesive (Scotch Clad 776)	3M Company, Adhesives, Coatings and Sealers Div, 3M Center, St Paul, MN 55101
R Chromic acid (Federal Specification O-C-303B)	Allied Chemical Corp, P.O. Box 4000R, Morristown, NY 07960
R Nitric acid (Federal Specification O-N-350)	McKesson Chemical Co, 4909 W Pasadena Ave, Glendale, AZ 85301
R Powder (Iridite No. 14-2)	Richardson Chemical Co, Allied Kelite Products Div, 400 Midland Ave, Highland Park, MI 48203

R A. (Codes A, B Post SB72-3085) Repair Fan Spinner Part No. 3072867-1 or 3072867-2 as Follows

R (1) Repair damage to fan spinner tip by grinding tip flat to a diameter not to exceed 0.100 inch maximum. Deburr grind and locally treat area to prevent corrosion.

R (2) Blend scratches and nicks which meet inspection criteria and that will not exceed 0.010 inch depth after blending.

R 4. A. (3) Locally treat surface blended areas to prevent corrosion as follows.

(a) Prepare aluminum touch-up solution as follows.

WARNING: TOUCH-UP SOLUTION IS AN ACID. USE CAUTION TO PREVENT CONTACT WITH SKIN. IF POWDER OR MIXED SOLUTION COMES IN CONTACT WITH SKIN, FLUSH OFF IMMEDIATELY WITH WATER. INHALATION OF DUST FROM THE POWDERS OR VAPORS FROM THE SOLUTION SHALL BE AVOIDED. SWABS, ETC., SATURATED WITH SOLUTION, CONSTITUTE FIRE HAZARDS IF ALLOWED TO DRY. IMMEDIATELY AFTER USE, RINSE THOROUGHLY IN TAP WATER.

1) Mix four ounces of powder (Iridite No. 14-2) in each gallon of water used.

NOTE: Make major adjustments of pH with chromic acid, as excessive use of nitric acid will precipitate the treatment chemicals in the form of a sludge.

2) Maintain pH of 0.9 to 1.1 using chromic acid (Federal Specification O-C-303B) and nitric acid (Federal Specification O-N-350).

3) Maintain solution at room temperature.

4) Allow solution to stand at least two hours before use.

(b) Spot treat areas where base metal is exposed, with aluminum touch-up solution.

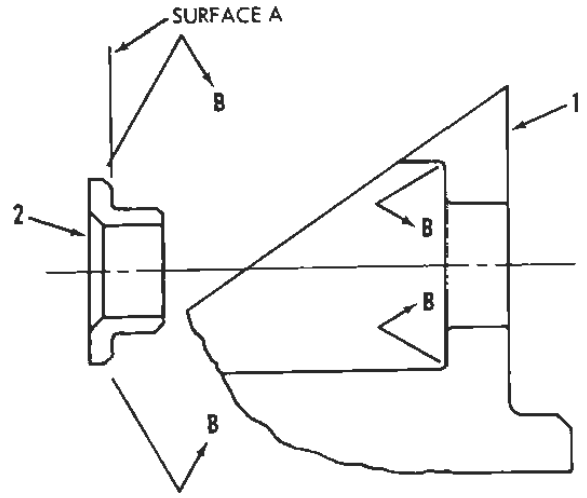
(c) Allow treated area to remain wet for one minute. Rinse in warm tap water at 27 to 43C (80 to 110F). Air-dry using clean, dry, filtered compressed air at 20 psig maximum or oven dry for 30 minutes at 79 to 107C (175 to 225F).

R CAUTION: DO NOT APPLY HEAT TO FAN SPINNER TO
R AID ADHESIVE DRYING, ADHESIVE MUST
R DRY AT ROOM TEMPERATURE FOR 72 HOURS.

R NOTE: If bushings (9, figure 201) are in-
R stalled with adhesive, refer to SB72-
R 3085.

R 4. A. (4) Install or replace bushings as follows (see figure
R 201).

R (Fan Spinner Part No. 3072867-1 or 3072867-2) Clean
R areas enclosed with "B" on fan spinner (1) and bushing
R (2) Figure 202 using clean cloth dampened with
R trichloroethylene. Apply adhesive (Scotch Clad 776) to
R Surface "A" of bushing (2). Install bushing (2) into
R position in fan spinner (1). Assemble fan spinner to
R spinner support using bolts (7, figure 201). Tighten
R bolts (7) to torque of 60 inch-pounds and allow adhe-
R sive 72 hours to cure at room temperature prior to
R installation.



SB-3980

1. FAN SPINNER (PART NO. 3072867-1, -2)
2. BUSHING (PART NO. 3072875-1)

Bushing Installation
Figure 202

R 4. B. Replace Damaged Nuts on Spinner Support

R (1) Remove damaged nuts on spinner support using a punch.

R (2) Install new nut in spinner support and secure using
R 293328-1 nutplate wrench set.

R (3) Check run-down torque on replaced nut using a new bolt.
R Run-down torque shall be at least six inch-pounds.

FAN ROTOR ASSEMBLY INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Special Tools, Fixtures and Equipment

Item No.	Nomenclature	Use	Source/ Part No.
NOTE: Equivalent substitutes may be used for listed items.			
1.	Mechanical Puller Set	Removes retainer.	289767-1
2.	Fan Assembly Hydraulic Puller	Removes fan rotor assembly.	289768-1 or 289768-2
R 3. R	Fan Drive Shaft Elongation Gage	(Code C) (Codes A, B Pre SB72-3085) Permits fan shaft stretch measurement.	291266-1
4. R R	*Fan Shaft Stretching Fixture (with cylinder and pump)	Stretches fan shaft.	293002-1 or 293002-2
5.	**Ring Positioning Wrench	Used to properly seat pressed in bushing ring in forward internal diameter of disc of fan rotor assembly.	293014-1

NOTE: *A fluorescent penetrant inspection in accordance with Specification MIL-I-6866, Type I, is required
R on 290947-1 threaded rod and 290489-2 nut to ensure serviceability at 60 day intervals or after each 100 times fixture is loaded (whichever occurs first). Maintain a permanent record with stretching fixture to record number and dates of fixture loadings and dates of inspections. Life limit of 292033-2 threaded rod and 290489-2 nut is 10,000 fixture loadings. These components shall be replaced at or before reaching life limit.

**Item 5 is required for assembly of 3071537-3 or 3071537-5 fan rotor assembly which utilizes a pressed-in pilot ring on forward internal diameter of fan disc.

Table 202. Materials and Compounds

Material or Compound	Manufacturer
CAUTION: ANY SUBSTITUTES USED FOR LISTED INDUSTRIAL MARKING INK OR YELLOW CHINA MARKER SHALL CONTAIN NO CARBON.	
NOTE: Equivalent substitutes may be used for listed items.	
Industrial marking ink (Violet, No. 127-1/2)	Pannier Corp, 207 Sandusky St, Pittsburgh, PA 15212
Lubricating compound (Liqui-Moly, Grade NV, Thread Compound)	Lockrey Co, Lubricants Div, Cedar Shores, Southampton, NY 11968
Yellow china marker (No. 170T)	Blaisdell Pencil, Co. Philmont Rd, Bethagres, PA 19006

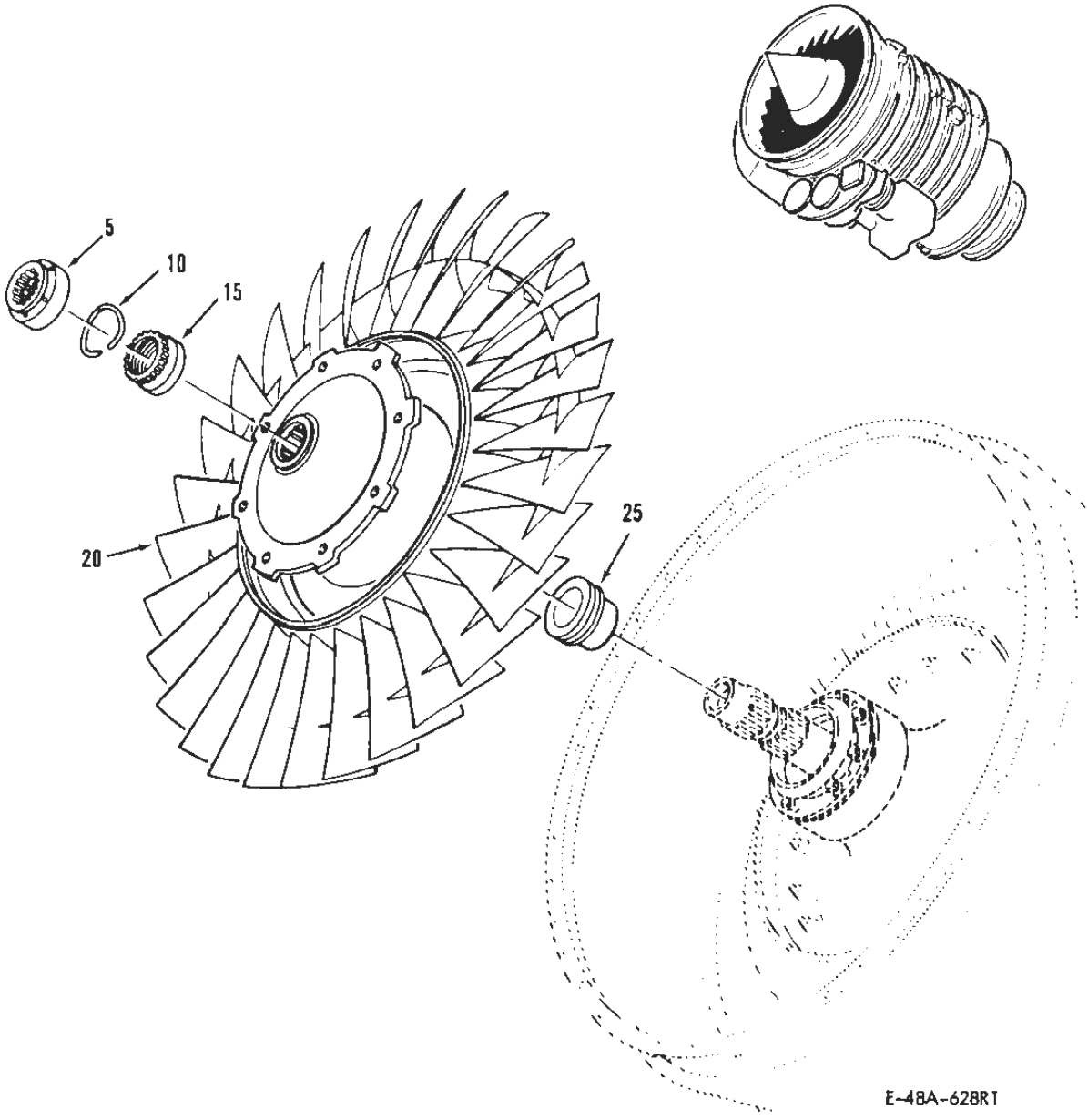
1. A. Remove Fan Rotor Assembly (See Figure 201)

R (1) Remove fan spinner and spinner support installation in
R accordance with 72-70-01, MAINTENANCE PRACTICES.

R (2) Deleted.

(3) Remove nut retainer using 289767-1 puller set. Remove retainer ring.

R



R 5. NUT RETAINER (IPC FIG. 72)
R 10. RETAINER RING
R 15. NUT
20. FAN ROTOR ASSY
25. AIR-OIL SEAL

Fan Rotor Assembly Installation
Figure 201

WARNING: DO NOT STAND IN LINE WITH, ABOVE, OR BELOW SHAFT STRETCH FIXTURE WHEN PRESSURE IS APPLIED TO FIXTURE IN THE FOLLOWING STEPS. A FAILURE OF FAN SHAFT OR FIXTURE WOULD EXPEL FIXTURE FORWARD WITH CONSIDERABLE FORCE.

CAUTION: WHEN PERFORMING THE FOLLOWING PROCEDURE, MAKE CERTAIN FORCE SPECIFIED IS NOT EXCEEDED TO ENSURE SHAFT IS NOT OVERSTRETCHED. ENSURE PROPER SPECIAL TOOLING IS USED.

NOTE: Removal of the rotor assembly nut requires a vibration check after reinstallation. Refer to 72-00-00, GENERAL - ADJUSTMENT/TEST, paragraph 12.

R 1. A. (4) Remove nut using 293002-1 or 293002-2 fixture as follows.

(a) Disassemble 293002-1 or 293002-2 fixture to separate threaded rod. Clean threads of fixture components and mating threads for fixture on engine component. Lubricate threads on threaded rod of fixture and threads of fan shaft with a light coat of lubricating compound (Liqui-Moly, Grade NV, thread compound).

CAUTION: ENSURE ROD PORTION OF FIXTURE ENGAGES A MINIMUM OF TEN AND ONE-HALF THREADS IN INTERNAL BORE OF FAN SHAFT WHEN PERFORMING THE FOLLOWING STEP TO ENSURE PROPER INSTALLATION OF FIXTURE.

(b) Thread fixture rod portion of 293002-1 or 293002-2 fixture into internal threads of fan shaft until it bottoms in shaft, counting turns of thread engagement. A minimum number of ten and one-half turns ensures proper installation of rod.

(c) Ensure fan rotor assembly does not turn and back fixture rod out one-half turn.

CAUTION: ENSURE WING NUT OF FIXTURE ENGAGES A MINIMUM OF SEVEN THREADS WHEN PERFORMING THE FOLLOWING STEP TO ENSURE PROPER INSTALLATION OF FIXTURE.

(d) Carefully assemble adapter and cylinder assembly of fixture over fixture rod. Secure assembly with wing nut on end of fixture rod while holding fixture against fan rotor assembly.

1. A. (4) (e) Install wing nut to bottoming position, then back wing nut out one turn.

(f) Use hand pressure to align cylinder assembly of fixture concentrically with fixture rod, then apply sufficient pressure with hydraulic pump of fixture to support cylinder in aligned position.

(g) Slowly continue to apply pressure with hydraulic pump of fixture until fixture pressure gage indicates 8300 psig.

CAUTION: WHEN REQUIRED TO INCREASE HYDRAULIC PRESSURE ON FIXTURE AS SPECIFIED IN THE FOLLOWING STEP, DO NOT EXCEED MAXIMUM HYDRAULIC PRESSURE SPECIFIED ON FIXTURE.

(h) Rotate fan shaft nut counterclockwise. If fan shaft nut will not turn, relieve hydraulic pressure on fixture and repeat steps (f) through (h) to loosen nut. If fan shaft nut will not loosen after four repetitions, repeat steps (f) through (h) with hydraulic pressure increased 50 psig over previously used hydraulic pressure. Continue repetitions until fan shaft nut is loosened, but do not exceed maximum hydraulic pressure specified on fixture.

(i) Rotate fan shaft nut counterclockwise two turns.

(j) Slowly relieve hydraulic pressure, then remove fixture. Remove fan shaft nut.

(5) Index position of fan rotor assembly relative to fan shaft using yellow china marker (No. 170T) or industrial marking ink (Violet, No. 127-1/2) to ensure same orientation at reassembly.

CAUTION: USE CARE WHEN REMOVING FAN ROTOR ASSEMBLY TO PREVENT SEAL FROM FALLING OUT OF AFT INTERNAL BORE TO PREVENT DAMAGE TO AIR-OIL SEAL.

NOTE: A record of cycles as specified in Service Bulletin 72-3001 shall be maintained on disc of fan rotor assembly throughout life of part.

(6) Attach 289768-1 or 289768-2 puller to rotor assembly with screws. Apply pressure to puller with hydraulic pump to pull rotor assembly from fan shaft. Hydraulic pump is part of 289768-2 puller. Use hydraulic pump

R portion of 293002-1 or 293002-2 shaft stretching fixture when using 289768-1 puller. Remove air-oil seal from bore of fan rotor assembly.

1. A. (7) Remove puller by removing screws from rotor assembly.

B. Install Fan Rotor Assembly (See Figure 201)

(1) Install air-oil seal in bore of fan rotor assembly. Install fan rotor assembly so that splines are engaged with splines on shaft assembly in same orientation indexed at removal.

WARNING: DO NOT STAND IN LINE WITH, ABOVE, OR BELOW SHAFT STRETCH FIXTURE WHEN PRESSURE IS APPLIED TO FIXTURE IN THE FOLLOWING STEPS. A FAILURE OF FAN SHAFT OR FIXTURE WOULD EXPEL FIXTURE FORWARD WITH CONSIDERABLE FORCE.

CAUTION: WHEN PERFORMING THE FOLLOWING PROCEDURE, MAKE CERTAIN FORCE SPECIFIED IS NOT EXCEEDED TO ENSURE SHAFT IS NOT OVERSTRETCHED. IF SPECIFIED STRETCH IS EXCEEDED, APPLY PRESSURE WITH SHAFT STRETCH FIXTURE (NOT TO EXCEED PRESSURE SPECIFIED FOR SHAFT STRETCH FIXTURE USED) SUFFICIENT TO LOOSEN FAN SHAFT NUT, RELIEVE HYDRAULIC PRESSURE ON FIXTURE, AND REPEAT PROCEDURE. ENSURE PROPER SPECIAL TOOLING IS USED.

IF FAN SHAFT IS ABOVE AMBIENT TEMPERATURE, ALLOW TO COOL AS REQUIRED UNTIL BARE HAND MAY BE RESTED ON FAN SHAFT BEFORE PERFORMING THE FOLLOWING PROCEDURE. IF NOT COOLED AS SPECIFIED, FAN SHAFT MAY BE OVERSTRETCHED WHEN THE FOLLOWING PROCEDURE IS PERFORMED.

R (2) Stretch fan shaft as follows using 293002-1 or 293002-2 fixture to obtain dimensional stretch of 0.0040 to 0.0045 inch.

R 1. B. (2) (a) (Code C) (Codes A, B Pre SB72-3085) Install
R 291266-1 gage in fan shaft and measure dimension
R from end of fan shaft to end of gage for zero
R shaft stretch measurement. Index point on end of
R fan shaft using yellow china marker (No. 170T) or
R industrial marking ink (Violet No. 127-1/2) where
R measurement is taken. Load 291266-1 gage into fan
R shaft when taking measurement.

R (b) (Codes A, B Post SB72-3085) Using a depth gage,
R insert gage in bore of fan shaft mid-way between
R shaft center line and shaft ID until contact with
R plug. Take zero shaft stretch measurement, index
R points on end of fan shaft where measurement is
R taken with industrial marking ink (Violet No. 127-
R 1/2) or yellow china marker (No. 170T).

R (c) Disassemble 293002-1 or 293002-2 fixture to
R separate threaded rod. Clean threads of fixture
R components and mating threads for fixture on en-
R gine component. Lubricate threads on threaded rod
R of fixture with a light coat of lubricating com-
R pound (Liqui-Moly, Grade NV, thread compound).

CAUTION: ENSURE ROD PORTION OF FIXTURE ENGAGES A MINIMUM OF TEN AND ONE-FOURTH THREADS IN INTERNAL BORE OF FAN SHAFT WHEN PERFORMING THE FOLLOWING STEP TO ENSURE PROPER INSTALLATION OF FIXTURE.

NOTE: Accomplishment of steps (d) through (i) are not required unless 3071537-3 or 3071537-5 fan rotor assembly (with pressed-in pilot ring on forward internal diameter of fan disc) is being installed.

(d) (3071537-3 or 3071537-5 fan rotor assembly)
R Thread fixture rod portion of 293002-1 or 293002-2
fixture into internal threads of fan shaft until
rod bottoms in shaft, counting number of turns of
thread engagement. A minimum of ten and one-
fourth turns ensures proper installation of rod.

(e) (3071537-3 or 3071537-5 fan rotor assembly) Back
R fixture rod portion of 293002-1 or 293002-2 fix-
ture out one-fourth turn.

CAUTION: ENSURE WING NUT OF FIXTURE ENGAGES A MINIMUM OF SIX AND ONE-HALF THREADS WHEN PERFORMING THE FOLLOWING STEP TO ENSURE PROPER INSTALLATION OF FIXTURE.

1. B. (2) (f) (3071537-3 or 3071537-5 fan rotor assembly) Carefully assemble adapter and cylinder assembly of fixture over fixture rod. Secure assembly with wing nut on end of fixture rod while holding fixture against fan rotor assembly. Install wing nut to bottoming position, then back wing nut out one-half turn.

(g) (3071537-3 or 3071537-5 fan rotor assembly) Use hand pressure to align cylinder assembly of fixture concentrically with fixture rod, then apply sufficient pressure with hydraulic pump of fixture to support cylinder in aligned position.

(h) (3071537-3 or 3071537-5 fan rotor assembly) Slowly continue to apply pressure with hydraulic pump of fixture until fixture pressure gage indicates 3000 to 4000 psig to press fan rotor assembly into position. Relieve hydraulic pressure on fixture and remove fixture.

(i) (3071537-3 or 3071537-5 fan rotor assembly) Thread 293014-1 wrench onto fan shaft and tighten flush with forward surface of fan rotor assembly to ensure proper seating of pressed-in ring. Remove 293014-1 wrench.

(j) Apply lubricating compound (Liqui-Moly, Grade NV, thread compound) to threads of shaft, nut and nut face, then thread nut onto fan shaft until hand tight. Ensure nut is seated against fan rotor assembly.

CAUTION: ENSURE ROD PORTION OF FIXTURE ENGAGES A MINIMUM OF TEN AND ONE-FOURTH THREADS IN INTERNAL BORE OF FAN SHAFT WHEN PERFORMING THE FOLLOWING STEP TO ENSURE PROPER INSTALLATION OF FIXTURE.

R (k) Thread fixture rod portion of 293002-1 or 293002-2 fixture into internal threads of fan shaft until fixture rod bottoms in shaft, counting number of turns of thread engagement. A minimum of ten and one-fourth turns ensures proper installation of rod.

R 1. B. (2) (l) Back fixture rod portion of 293002-1 or 293002-2 fixture out one-fourth turn.

CAUTION: ENSURE WING NUT OF FIXTURE ENGAGES A MINIMUM OF SIX AND ONE-HALF THREADS WHEN PERFORMING THE FOLLOWING STEP TO ENSURE PROPER INSTALLATION OF FIXTURE.

(m) Carefully assemble adapter and cylinder assembly of fixture over fixture rod. Secure assembly with wing nut on end of fixture rod while holding fixture against fan rotor assembly. Install wing nut to bottoming position, then back wing nut out one-half turn.

(n) Use hand pressure to align cylinder assembly of fixture concentrically with fixture rod, then apply sufficient pressure with hydraulic pump of fixture to support cylinder in aligned position.

(o) Slowly continue to apply pressure with hydraulic pump of fixture until fixture pressure gage indicates 7200 psig.

(p) Slowly relieve hydraulic pressure on fixture, do not remove fixture.

R (q) Slowly continue to reapply pressure with hydraulic
R pump of fixture until fixture pressure gage indi-
R cates 7200 psig, while turning fan shaft nut keep-
R ing it hand tight as pressure is applied.

R (r) Slowly relieve hydraulic pressure on fixture and
R remove fixture.

CAUTION: WHEN REQUIRED TO INCREASE HYDRAULIC PRESSURE ON FIXTURE AS SPECIFIED IN THE FOLLOWING STEP, DO NOT EXCEED MAXIMUM HYDRAULIC PRESSURE SPECIFIED ON FIXTURE.

R (s) (Code C) (Codes A, B Pre SB72-3085) Measure fan
R shaft stretch at previously indexed mark to ensure fan shaft has been stretched 0.0040 to 0.0045 inch (measured from end of fan shaft to end of 291266-1 gage. Load 291266-1 gage into fan shaft for measurement). If stretch is less than required, repeat steps (k) through (r) with hydraulic pressure applied in step (o) increased 200 psig at each repetition of procedure until specified shaft stretch is obtained. Do not exceed maximum hydraulic pressure specified on fixture.

R 1. B. (2) (t) (Codes A, B Post SB72-3085) Measure fan shaft, at previously indexed mark, to ensure fan shaft has been stretched 0.0040 to 0.0045 inch (measured from plug to end of fan shaft). If stretch is less than required, repeat steps (k) through (p) with hydraulic pressure applied in step (o) increased 200 psig at each repetition of procedure until specified shaft stretch is obtained. Do not exceed maximum hydraulic pressure specified on fixture.

(3) Locate orientation of nut retainer for fit over fan shaft nut and mark position relative to fan rotor assembly with yellow china marker (No. 170T) or industrial marking ink (Violet, No. 127-1/2). Remove nut retainer and install ring, and then install nut retainer at indexed position to lock nut.

R (4) Install fan spinner and spinner support installation in accordance with 72-70-01, MAINTENANCE PRACTICES.

R (5) Perform vibration check in accordance with 72-00-00, GENERAL - ADJUSTMENT/TEST, paragraph 12 or 13.

2. Inspection/Check

A. Inspect Fan Rotor Assembly

(1) Inspect fan hub for distortion and rear side of hub for rub marks.

(2) Check fan blades for nicks, cracks, or distortion.

NOTE: When any foreign object damage to fan blades has occurred, perform borescope inspection of first stage compressor blades in accordance with 72-00-00, GENERAL - INSPECTION/CHECK, step 10.A.(3).

(3) Check installed fan blade lockplates for visible cracks.

(4) Check fan blades for axial movement at base of blade. Axial movement of 0.015 inch is maximum allowable.

(5) Check nuts on disc and hub for security and for stripped or damaged threads. Check nuts for minimum rundown torque using a new bolt (72-70-01, 25 or 35, figure 201). Some radial movement is acceptable. Stripped or damaged threads are not acceptable. Rundown torque shall be 12 inch-pounds minimum. If rundown torque is not as specified, replace nut in accordance with 4, Approved Repairs. (See figure 204.)

2. A. (6) Replace items if inspection requirements of steps (1) through (5) are not met and blades are damaged beyond repair limits of 4, Approved Repairs.

B. Inspect Air-Oil Seal

(1) Inspect knife-edges of air-oil seal for knife tip wear, axial deformation of knife-edge outside diameters, marked discoloration of knife tips due to heavy rubbing, and pickup of abradable material on knife edges. Axial deformation shall not exceed 0.050 inch. Remove any abradable material on knife edges by hand finishing. Wear on outside diameter of seal knife-edges is acceptable if within the following limits.

(a) Uniform wear is acceptable if diameter of all knife-edge blades are not less than 3.629 inches.

2. B. (1) (b) Eccentric wear is acceptable if outside diameter of all knife-edge blades is not less than 3.628 inches (at maximum eccentric wear) and eccentric wear does not exceed 90 degrees of circumference. Remainder of wear shall be uniform and within the limits of step (a).

(2) Inspect aft mating surface of seal (surface that mates with seal rotor) for nicks or scratches that could affect sealing reliability. Remove scratches or nicks by polishing.

3. Cleaning/Painting

Table 203. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Methyl-ethyl-ketone (MEK) (TT-M-261)	Commercially available

A. Clean Parts

(1) Clean nut retainer, retainer ring, nut and air-oil seal in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method No. 1 or 2.

(2) Clean fan rotor assembly by brushing assembly with methyl-ethyl-ketone (MEK) (TT-M-261) as required.

4. Approved Repairs

Table 204. Special Tools, Fixtures and Equipment

Item No.	Nomenclature	Use	Source/ Part No.
NOTE: Equivalent substitutes may be used for listed items.			
1.	Fan Blade Installation and Removal Fixture	Supports fan rotor assembly for blade removal and installation.	289919-1
2.	Lockplate Removal Fixture	Used to straighten lockplates securing fan blades.	289922-1
3.	Lockplate Removal Pliers	Used to remove lockplates.	293218-1
4.	Nutplate Wrench Set	Used to install nuts on fan rotor assembly.	293328-1

Table 205. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Dry-film lubricant (Molykote 321R)	Dow Corning Corp, S Saginaw Rd, Midland, MI 48640

NOTE: Perform borescope inspection of first stage compressor blades in accordance with 72-00-00, GENERAL - INSPECTION/CHECK, step 10.A.(3) to determine if compressor blades were damaged when fan blade damage occurred.

4. A. Repair Individual Fan Blades (Installed) by Blending

NOTE: Repair damaged blades by removing damaged material. To maintain part integrity and prevent performance loss, material removal shall be limited to meet both of the following requirements.

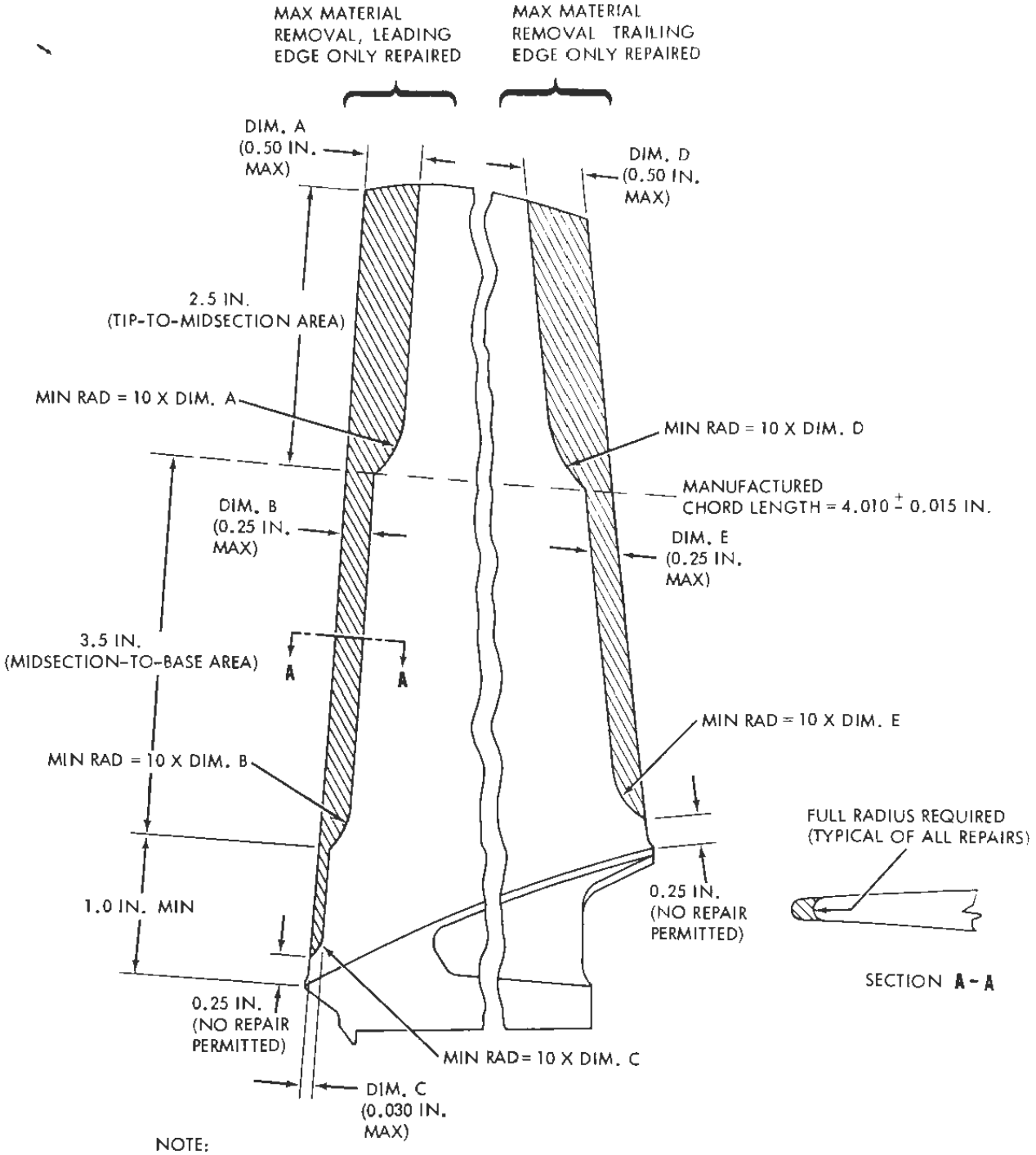
(1) Maximum allowable material removal on any single blade shall not exceed limits of Figures 202 and 203.

(2) Total leading and trailing edge material for a set of 30 blades which may be removed shall not exceed 7.50 square inches in the tip-to-midsection area and 5.25 square inches in the midsection-to-base area. (See figure 202.) Removed material may be distributed as required on leading and trailing edges of any number of blades as long as the limits of step (1) are not exceeded on any one blade. (Removed material limit would be reached for the complete set of 30 blades by repairing six blades to the full limits of step (1).)

Blade repair is limited to material removal from the leading and trailing edges, the tip, and the midspan damper as specified in Figures 202 and 203. Repair blades in pairs. A blade pair consists of blades installed 180 degrees apart. Blade blending of any one blade shall be identical to blending of blade installed at 180 degrees. Remove material only to the extent required to remove damaged material and meet limits of Figures 202 and 203.

(1) Remove fan rotor assembly. Refer to 1, Removal/Installation.

(2) Repair blade with over-all leading or trailing edge damage. (See figure 202.)


MAX MATERIAL REMOVAL, LEADING EDGE ONLY REPAIRED
MAX MATERIAL REMOVAL TRAILING EDGE ONLY REPAIRED
DIM. A (0.50 IN. MAX)
DIM. D (0.50 IN. MAX)
2.5 IN. (TIP-TO-MIDSECTION AREA)
MIN RAD = 10 X DIM. A
MIN RAD = 10 X DIM. D
MANUFACTURED CHORD LENGTH = 4.010 ± 0.015 IN.
DIM. B (0.25 IN. MAX)
DIM. E (0.25 IN. MAX)
3.5 IN. (MIDSECTION-TO-BASE AREA)
A
A
MIN RAD = 10 X DIM. E
MIN RAD = 10 X DIM. B
FULL RADIUS REQUIRED (TYPICAL OF ALL REPAIRS)
1.0 IN. MIN
0.25 IN. (NO REPAIR PERMITTED)
SECTION A-A
0.25 IN. (NO REPAIR PERMITTED)
MIN RAD = 10 X DIM. C
DIM. C (0.030 IN. MAX)

NOTE:

SHADED AREA SHOWS MAXIMUM ALLOWABLE MATERIAL REMOVAL.

DIMENSIONS ILLUSTRATED ARE APPLICABLE WHEN MATERIAL REMOVAL EXTENDS TO TIP.

MATERIAL MAY BE REMOVED FROM BOTH LEADING AND TRAILING EDGES AS LONG AS CHORD LENGTH REDUCTION DOES NOT EXCEED 0.50 INCH IN TIP-TO-MIDSECTION AREA AND 0.25 INCH IN MIDSECTION-TO-BASE AREA.

CALCULATE TOTAL AREA OF REMOVED MATERIAL ON ALL REPAIRED BLADES TO ENSURE LIMITS FOR 30-BLADE SET ARE NOT EXCEEDED.

I-48A-359

Repair Limits for Fan Blade Leading and Trailing Edges
Figure 202

4. A. (2) (a) Blend leading or trailing edge of fan blade to remove damage if damage does not exceed allowable repair limits. Remove material in accordance with step (7).

(b) After rework of damaged blade, make template of reworked blade to guide rework of opposing blade of blade repair.

(c) Blend opposing blade, located 180 degrees from reworked blade, identically to reworked blade using template. Remove material in accordance with step (7).

(3) Repair blade with tip damage. (See figure 203.)

(a) Blend fan blade tip to remove damage if damage does not exceed allowable repair limits. Remove material in accordance with step (7).

(b) After rework of damaged blade, make template of reworked blade to guide rework of opposing blade of blade pair.

(c) Blend tip of opposing blade, located 180 degrees from reworked blade, identically to reworked blade using template. Remove material in accordance with step (7).

(4) Repair blade with leading edge damage 1.0 inch or more above blade root or trailing edge damage more than 0.25 inch from blade root. (See figure 203.)

(a) Blend leading or trailing edge of fan blade to remove damage if damage does not exceed allowable repair limits. Remove material in accordance with step (7).

(b) After rework of damaged blade, make template of reworked blade to guide rework of opposing blade of blade pair.

(c) Blend leading or trailing edge of opposing blade, located 180 degrees from reworked blade, identically to reworked blade using template. Remove material in accordance with step (7).

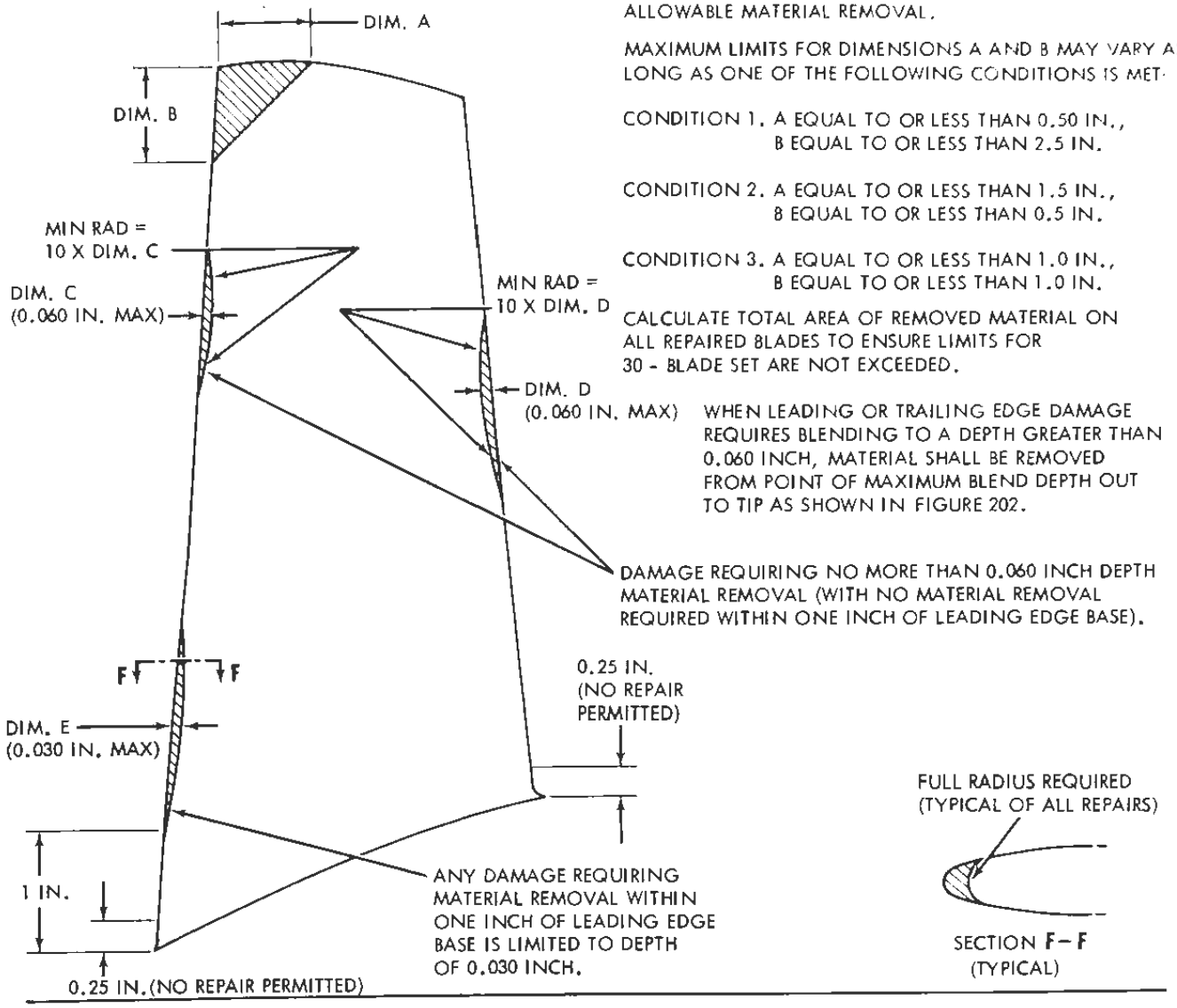
(5) Repair blade with leading edge damage less than 1.0 inch from blade root. (See figure 203.)

(a) Blend leading edge of fan blade to remove damage if damage does not exceed allowable repair limits. Remove material in accordance with step (7).

4. A. (5) (b) After rework of damaged blade, make template of reworked blade to guide rework of opposing blade of blade pair.

(c) Blend leading edge of opposing blade, located 180 degrees from reworked blade, identically to reworked blade using template. Remove material in accordance with step (7).

TIP REPAIR AND MINOR BLENDING REPAIR OF LEADING AND TRAILING EDGES


DIM. A
DIM. B
MIN RAD = 10 X DIM. C
DIM. C (0.060 IN. MAX)
MIN RAD = 10 X DIM. D
DIM. D (0.060 IN. MAX)
F
F
DIM. E (0.030 IN. MAX)
0.25 IN. (NO REPAIR PERMITTED)
1 IN.
0.25 IN. (NO REPAIR PERMITTED)
FULL RADIUS REQUIRED (TYPICAL OF ALL REPAIRS)
SECTION F-F (TYPICAL)

NOTE: SHADED AREA SHOWS MAXIMUM ALLOWABLE MATERIAL REMOVAL.

MAXIMUM LIMITS FOR DIMENSIONS A AND B MAY VARY AS LONG AS ONE OF THE FOLLOWING CONDITIONS IS MET.

CONDITION 1. A EQUAL TO OR LESS THAN 0.50 IN., B EQUAL TO OR LESS THAN 2.5 IN.

CONDITION 2. A EQUAL TO OR LESS THAN 1.5 IN., B EQUAL TO OR LESS THAN 0.5 IN.

CONDITION 3. A EQUAL TO OR LESS THAN 1.0 IN., B EQUAL TO OR LESS THAN 1.0 IN.

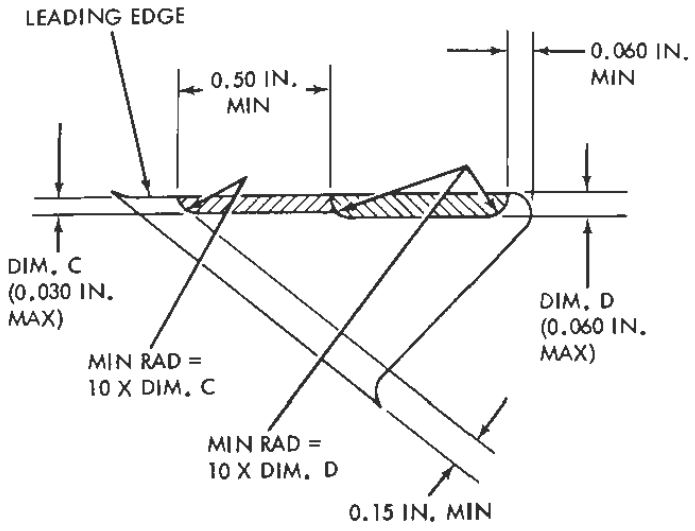
CALCULATE TOTAL AREA OF REMOVED MATERIAL ON ALL REPAIRED BLADES TO ENSURE LIMITS FOR 30 - BLADE SET ARE NOT EXCEEDED.

WHEN LEADING OR TRAILING EDGE DAMAGE REQUIRES BLENDING TO A DEPTH GREATER THAN 0.060 INCH, MATERIAL SHALL BE REMOVED FROM POINT OF MAXIMUM BLEND DEPTH OUT TO TIP AS SHOWN IN FIGURE 202.

DAMAGE REQUIRING NO MORE THAN 0.060 INCH DEPTH MATERIAL REMOVAL (WITH NO MATERIAL REMOVAL REQUIRED WITHIN ONE INCH OF LEADING EDGE BASE).

ANY DAMAGE REQUIRING MATERIAL REMOVAL WITHIN ONE INCH OF LEADING EDGE BASE IS LIMITED TO DEPTH OF 0.030 INCH.

MIDSPAN DAMPER LEADING EDGE DAMAGE REPAIR LIMITS



NOTE: SHADED AREA SHOWS MAXIMUM ALLOWABLE MATERIAL REMOVAL. COMPLY WITH RADIUS REQUIREMENTS OF SECTION F-F.

1-48A-358

Repair Limits for Fan Blade Tip Repair and Minor Blending of Leading and Trailing Edges
Figure 203

4. A. (6) Repair blade with midspan damper damage. (See figure 203.)

(a) Blend leading edge of midspan damper to remove damage if damage does not exceed allowable repair limits. Remove material in accordance with step (7).

(b) After rework of damaged blade, make template of reworked blade to guide rework of opposing blade of blade pair.

(c) Blend leading edge of midspan damper on opposing blade, located 180 degrees from reworked blade, identically to reworked blade using template.

(7) Observe material removal and rework finishing requirements for all blade or midspan damper repair.

CAUTION: USE EXTREME CAUTION WHEN USING GRINDER OR ROTARY FILE FOR MATERIAL REMOVAL TO ENSURE THAT TITANIUM IS NOT OVERHEATED AND THAT NO MATERIAL DISCOLORATION OCCURS. OVERHEATING TITANIUM CAUSES A DETRIMENTAL CASE WHICH IS VERY SUSCEPTIBLE TO CRACKING.

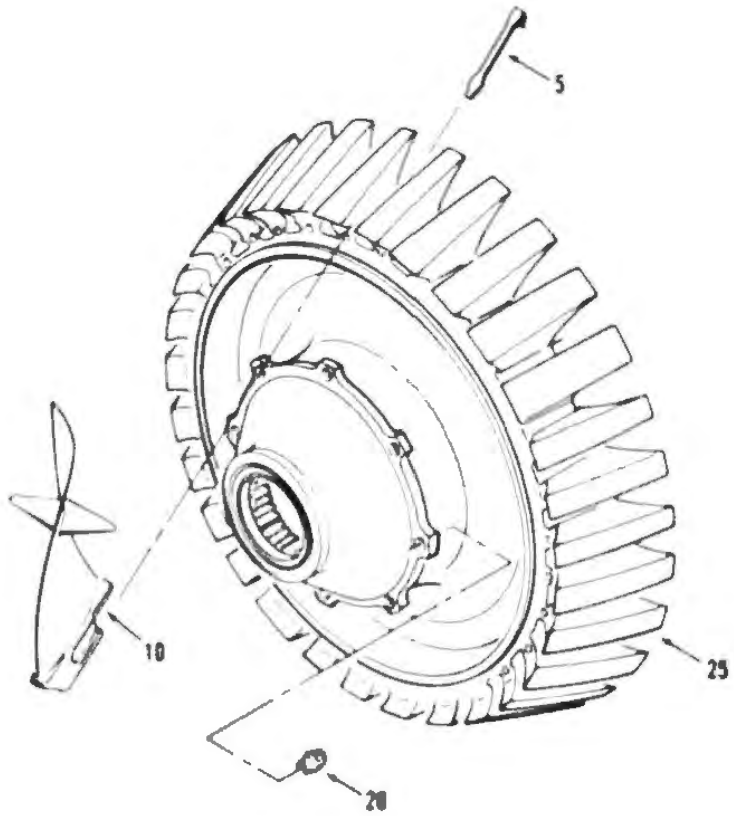
(a) Use rotary file or hand grinder for initial material removal. A hacksaw may be used if adequate material remains to allow final finishing without exceeding any limits specified in Figures 202 and 203. After using hacksaw, blend reworked area using hand grinder or rotary file. Full radius is required on edges of blade or midspan damper of reworked areas. See Figure 202.

(b) Perform final finishing with a hand file and by stoning. Final surface finish of reworked areas shall be AA32 or smoother.

NOTE: Perform a vibration survey in accordance with 72-00-00, GENERAL - ADJUSTMENT/TEST, paragraph 12, after installation.

(8) Install fan rotor assembly. Refer to 1, Removal/Installation.

R



E-48A-1808

R 5. LOCKPLATE (IPC FIG. 73)
R 10. BLADE
20. NUT
25. DISC AND HUB

Fan Rotor Assembly
Figure 204

NOTE: Replacement of individual fan blades requires simultaneous removal of all blades because of the interlocking midspan dampeners.

4. B. Remove and Replace Individual Fan Blades (Maximum of Ten) if Damaged Beyond Repair as Outlined in Paragraph 4.A (See Figure 204)

NOTE: Check permanent aircraft records for previous repair. If total previous blade replacement plus the proposed replacement exceeds ten blades, balancing of the fan rotor assembly is required following repairs.

(1) Remove fan rotor assembly. Refer to 1, Removal/Installation.

(2) Install fan rotor assembly on 289919-1 fixture.

(3) Mark blades to allow reinstallation at same relative position on disc and hub using yellow china marker (No. 170T) or industrial marking ink (Violet, No. 127-1/2). Bend out tabs on lockplates using 289922-1 fixture and remove all blades and lockplates from disc and hub. Use 293218-1 pliers if necessary to remove lockplates.

(4) If permanent engine records show previous blade replacement, check all blade part numbers (marked at bottom of blade) to find positions of previously replaced blade(s). Total cumulative repairs shall not exceed tolerances specified in step (7).

NOTE: If damaged blade has been previously blended, then blade installed 180 degrees shall also be replaced since it was blended to match damaged blade.

(5) Note the moment weight number stamped on base of blades to be replaced. (Moment weight numbers for blades are determined at blade manufacture to the nearest one-tenth gram-inch. All blades are manufactured with moment weight within the range of 3000.0 to 3999.9 gram-inches. The thousands digit (3) and the decimal point are omitted from the number stamped on the blade. For example, a blade with a moment weight of 3305.9 gram-inches is stamped 3059.) Replacement blades are available in 13 moment weight ranges for aid in matching moment weight of removed blades.

NOTE: When replacing two adjacent blades in the following step, the total moment weight of the two defective blades may be matched with the total moment weight of the two replacement blades when the combined values provide a better match than can be obtained by matching single blade moment weights.

R 4. B. (6) Select replacement blade from available stock to match moment weight as close as possible to defective blade. Blade Part No. 3072163-1 may be used for replacement if moment weight requirements of step (7) are met.

(7) The maximum moment weight change per blade or adjacent blade grouping, in any 90-degree segment, of fan rotor assembly shall not exceed 40 gram-inches.

(8) Prepare previously installed blades for reinstallation on disc and hub by spraying dovetail area of blade bases with dry-film lubricant (Molykote 321R) to protect against titanium-to-titanium contact.

NOTE: Do not reuse any lockplates. Install blades with new lockplates.

(9) Simultaneously install all blades. Install blades with marked locations at same relative position on disc and hub as marked at blade removal. Install new lockplates with bent tab flush with aft surface of disc. Bend opposite (forward) end of lockplates 90 degrees toward tips of blades. (See figure 205.) Check for axial play in blade with hand pressure. Lockplate shall be replaced for any blade with axial play greater than 0.010 inch.

(10) Remove fan rotor assembly for 289919-1 fixture.

(11) Install fan rotor assembly. Refer to 1, Removal/Installation.

NOTE: Perform a vibration check in accordance with 72-00-00, GENERAL - ADJUSTMENT/TEST, paragraph 12 or 13.

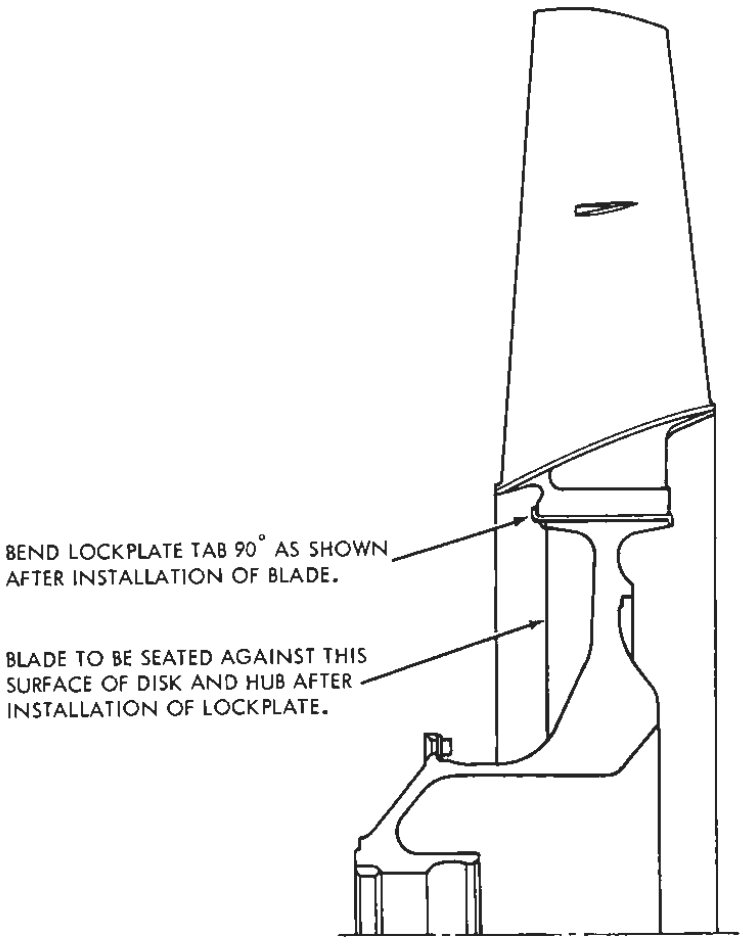
4. B. (12) Make entry in permanent engine records noting engine operating time and repair. Enter number of replaced blades.

C. Replace Damaged Nuts on Fan Rotor Assembly

(1) Remove damaged nuts on fan rotor assembly using a punch.

(2) Install new nut in fan rotor assembly and secure using 293328-1 nutplate wrench set.

R (3) Check rundown torque on replaced nut using a new bolt (72-70-01, 25 or 35, figure 201). Rundown torque shall be at least 12 inch-pounds.


BEND LOCKPLATE TAB 90° AS SHOWN AFTER INSTALLATION OF BLADE.
BLADE TO BE SEATED AGAINST THIS SURFACE OF DISK AND HUB AFTER INSTALLATION OF LOCKPLATE.
F-48A-184

Installation of Fan Rotor Assembly Lockplates
Figure 205

FAN BY-PASS STATOR INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

R Table 201. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed item.	
Lubricating compound (Liqui-Moly, Grade NV thread compound)	Lockrey Co, Lubricants Div, Cedar Shores, Southampton, NY 11968

A. Remove Fan By-Pass Stator (See Figure 201)

(1) (Code A) Disconnect engine wiring harness from inlet pressure and temperature sensor in accordance with 72-00-02, MAINTENANCE PRACTICES.

(2) (Codes A, B) Remove inlet pressure and temperature sensor components from fan inlet housing in accordance with 75-40-01, MAINTENANCE PRACTICES.

(3) Remove oil tank installation from fan inlet housing in accordance with 79-10-01, MAINTENANCE PRACTICES.

(4) Disconnect accessory drive gearbox forward mounting struts from fan inlet housing in accordance with 72-60-01, MAINTENANCE PRACTICES.

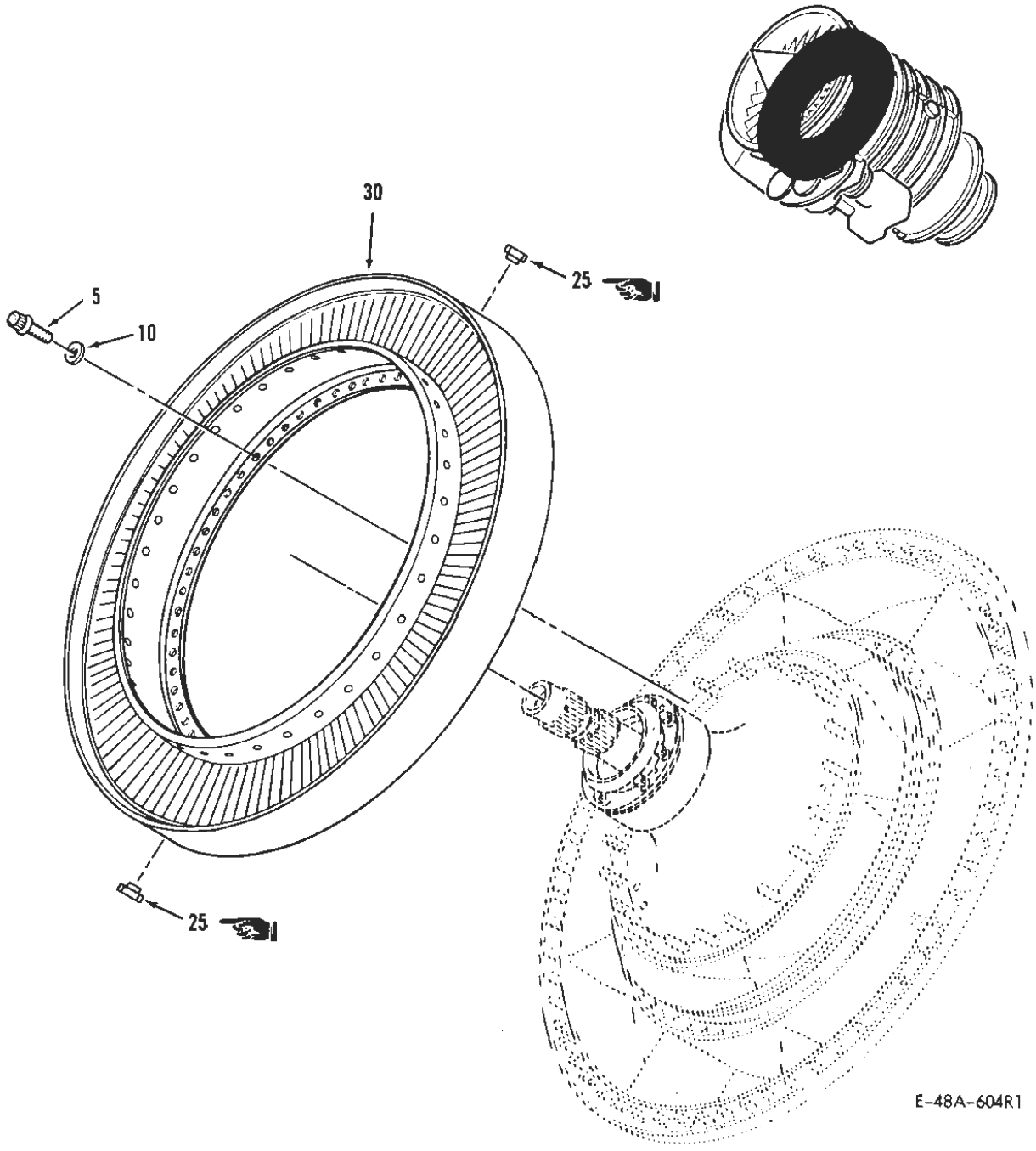
R (5) Remove fan spinner and spinner support installation in accordance with 72-70-01, MAINTENANCE PRACTICES.

R (6) Deleted.

(7) Remove fan rotor assembly in accordance with 72-70-03, MAINTENANCE PRACTICES.

(8) Remove fan inlet housing in accordance with 72-20-01. MAINTENANCE PRACTICES.

(9) Remove compressor inlet stator in accordance with 72-20-02, MAINTENANCE PRACTICES.



R 5. BOLT (IPC FIG. 82)
R 10. WASHER
25. PIN
30. FAN BY-PASS STATOR

Fan By-Pass Stator Installation
Figure 201

NOTE: (3071965-1 fan by-pass stator) Accomplishment of step (10) is required only for fan by-pass stators not incorporating welded tabs on inner shroud which lock assembly together.

1. A. (10) (3071965-1 fan by-pass stator) Turn outer shroud on fan by-pass stator counterclockwise to ensure assembly is locked together and tape outer shroud to inner shroud to prevent outer shroud from turning on inner shroud.

CAUTION: DO NOT APPLY AXIAL FORCE WHEN REMOVING BOLTS. AXIAL FORCE MAY CAUSE NUTPLATES FOR BOLTS TO DISENGAGE FROM MOUNTING SURFACE.

NOTE: All bolt holes for bolts removed in the following step may not be utilized due to inoperative or missing nutplates. Any damage at 1, Removal/Installation to nutplates exceeding any of the following conditions requires engine removal for repair.

(1) More than five nutplates missing or inoperative.

(2) Less than two operative nutplates to either side of a single missing or inoperative nutplate.

(3) Less than four operative nutplates to either side of two adjacent missing or inoperative nutplates.

(4) More than two adjacent missing or inoperative nutplates in any 90 degree segment of bolt circle.

(3071965-1 fan by-pass stator) Whenever tape is removed with fan by-pass stator removed from engine, handle with care to prevent vanes from disengaging shrouds.

(11) Remove bolts, washers, and fan by-pass stator.

1. B. Install Fan By-Pass Stator (See Figure 201)

CAUTION: DO NOT APPLY AXIAL FORCE WHEN INSTALLING BOLTS IN THE FOLLOWING STEP. AXIAL FORCE MAY CAUSE NUTPLATES FOR BOLTS TO DISENGAGE FROM MOUNTING SURFACE.

NOTE: All bolt holes may not be utilized due to inoperative or missing nutplates. Any damage at 1, Removal/Installation to nutplate exceeding any of the following conditions requires engine removal for repair.

(1) More than five nutplates missing or inoperative.

(2) Less than two operative nutplates to either side of a single missing or inoperative nutplate.

(3) Less than four operative nutplates to either side of two adjacent missing or inoperative nutplates.

(4) More than two adjacent missing or inoperative nutplates in any 90 degree segment of bolt circle.

Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

R (1) Apply light coat of lubricating compound (Liqui-Moly, R Grade NV, thread compound) to threads of bolts. In- R stall fan by-pass stator and secure with washers and R bolts. Tighten bolts (5) to torque of 60 inch-pounds. If installed, remove tape on inner and outer shrouds of fan by-pass stator.

(2) Install compressor inlet stator in accordance with 72-20-02, MAINTENANCE PRACTICES.

(3) Install fan inlet housing in accordance with 72-20-01, MAINTENANCE PRACTICES.

(4) Install fan rotor assembly in accordance with 72-70-03, MAINTENANCE PRACTICES.

R 1. B. (5) Install fan spinner and spinner support installation in accordance with 72-70-02, MAINTENANCE PRACTICES.

R (6) Deleted.

(7) Attach accessory drive gearbox forward mounting struts in accordance with 72-60-01, MAINTENANCE PRACTICES.

(8) Attach oil tank installation to fan inlet housing in accordance with 79-10-01, MAINTENANCE PRACTICES.

(9) (Codes A, B) Attach inlet pressure and temperature sensor components to fan inlet housing in accordance with 75-40-01, MAINTENANCE PRACTICES.

(10) (Code A) Attach engine wiring harness to inlet pressure and temperature sensor in accordance with 72-00-02, MAINTENANCE PRACTICES.

2. Inspection/Check

A. Inspect Fan By-Pass Stator

(1) Visually inspect vane leading and trailing edges for nicks and dents. Leading or trailing edge nicks with depth not exceeding 0.035 inch may be repaired by blending when no blending is required within 0.100 inch of inner or outer base, total number of blended vanes will not exceed 30, and limits of approved repairs can be met after repair. Refer to 4, Approved Repairs.

(2) Visually inspect vane concave sides for nicks and dents. More than five nicks and dents on concave side of any one vane is not allowed. Any nick or dent exceeding depth of 0.010 inch is not allowed. Repair allowable concave-side nicks and dents in accordance with 4, Approved Repairs.

(3) Visually inspect vane convex sides for nicks and dents. Convex-side nicks and dents are not allowed.

2. A. (4) Inspect vanes for lateral movement. Lateral movement of any vane up to a maximum of 0.100 inch is permissible for continued service except when performing periodic inspection of stator as specified in 72-00-00, INSPECTION/CHECK. When performing periodic inspection of stator as specified in 72-00-00, INSPECTION/CHECK, lateral movement of any vane in excess of 0.030 inch is not acceptable. For all stators other than Stator Part No. 3072727-1, refer to 4, Approved Repairs, when lateral movement of any vane exceeds specified dimension. For Stator Part No. 3072727-1, replace stator when lateral movement of any vane exceeds specified dimension.

R (5) Visually inspect welded retaining plates for cracks or broken welds. Refer to 4, Approved Repairs if cracked or broken weld is evident.

(6) Visually inspect for damaged aluminum surface finish. Refer to 4, Approved Repairs if damage is evident.

(7) Visually inspect inner and outer shrouds for cracks and distortion. Cracks and distortion are not allowed.

R (8) Check pins for security. Refer to 4, Approved Repairs
R for replacement of pins.

(9) Replace stator if inspection criteria of steps (1) through (7) is not met and damage is beyond scope of 4, Approved Repairs.

3. Cleaning/Painting

R Table 202. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Methyl-ethyl-ketone (MEK) (Federal Specification (TT-M-261)	Commercially available

A. Clean Parts

(1) Clean standard metallic hardware in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method No. 1 or 2.

R (2) Clean fan by-pass stator as follows.

(a) Wipe stator with cloth dampened with methyl-ethyl-ketone (MEK) (Federal Specification TT-M-261).

(b) Immerse stator in alkaline soak cleaning solution specified in 72-00-00, GENERAL - CLEANING/PAINTING, for two to four minutes and brush as required.

(c) Rinse stator in warm tap water at 27 to 43C (80 to 110F), then dry with clean compressed air.

4. Approved Repairs

R Table 203. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Abrasive paper (Federal Specification P-P-101)	Commercially available
Acetone (Federal Specification O-A-51C)	Commercially available
Abrasive (DC3145)(MIL-A-46146)	Dow Corning Corp, S Saginaw Rd, Midland, MI 48640
R Primer (P415-66-611B R and Catalyst C1178-66) R	Griggs Paint, Subsidiary of Domcom Dist, 3602 S 16th Place, Phoenix, AZ 85040
Primer (1200)	Dow Corning Corp, S Saginaw Rd, Midland, MI 48640
R Solvent, Stoddard (Federal R Specification P-D-680, R Type I or II)	Exxon Co, USA, P.O. Box 2180, 800 Bell Ave, Houston, TX 77001
Titanium (AMS4911) (0.025 inch thick)	Commercially available
Weld filler rod (AMS4954, 6AL-4V)	Commercially available

Table 204. Special Tools, Fixtures and Equipment

Item No.	Nomenclature	Use	Source/ Part No.
NOTE: Equivalent substitutes may be used for listed item.			
1.	Pin Driver Assembly	Removes and installs alignment pin.	294733-1

1. A. Repair Fan By-Pass Stator

(1) Repair vanes with repairable nicks and dents by blending damaged area to remove nick or dent. Blend length shall be 10 times blend depth. More than one blending operation may be performed on a vane edge if combined lengths of blends does not exceed 0.5 inch. Both leading and trailing edges of a vane may be blended if overall chord dimension is not reduced more than 0.040 inch. No blending is allowed within 0.100 inch of vane inner or outer base.

(2) Repair vanes with repairable nicks and dents on concave side by smoothing raised metal using crocus cloth or stone.

(3) (On stators other than Stator Part No. 3072727-1) Repair vanes with excessive lateral movement by welding with stator removed from engine.

(a) Fabricate retaining plates from titanium strips (per AMS4911) 0.025 inch thick and 0.325 to 0.425 inch wide, with length as required for segment to be welded. Minimum strip length shall be required to attach at least four vane ends.

(b) If present, remove adhesive and primer from ends of vanes on inner and outer shroud locations, where welding is to be performed using a power rotary stainless steel brush.

(c) Remove oxidation from areas to be welded with abrasive paper (Federal Specification P-P-101).

(d) Immediately prior to performing welding operation of the following step, thoroughly clean areas to be welded with acetone (Federal Specification O-A-51C).

(e) Weld new retaining plates, or any existing retaining plates with broken or damaged welds, to ends of vanes at inner or outer shroud locations using weld filler rod (AMS4954, 6AL-4V).

(f) Apply aluminum touch-up solution specified in 72-00-00, GENERAL - CLEANING/PAINTING to all bare aluminum surfaces in accordance with MIL-C-5541.

(g) Reapply adhesive (DC 3145) (MIL-A-46146) and primer (1200) as directed by manufacturer to all vane securing slots.

4. A. (3) (h) If any anodized surface is damaged, re-anodize surface in accordance with MIL-A-8625, Type I.

(4) Repair any cracked or broken welds on existing retaining plates of stator as specified in steps (3)(b) through (3)(h).

(5) Repair damaged aluminum surface finish as specified in steps (3)(f) and (h).

R (6) Replace alignment pins as follows.

R (a) Remove alignment pin using 294733-1 pin driver
R assembly.

R (b) Clean all surfaces with solvent, Stoddard (Federal
R Specification P-D-680, Type I or II).

R (c) Select a replacement pin that will ensure an in-
R terference fit of 0.0004 to 0.0016 inch and press
R into place using 294733-1 pin driver assembly.

R (d) Coat circumference of pin at mating point with
R stator with primer (P-415-66-611B and Catalyst
R C1178-66). Wipe soft primer with dry cloth to
R remove excessive buildup on flat surfaces. Allow
R primer to dry 5 to 30 minutes, then cure at 82 to
R 135C (180 to 275F) for one hour.

FAN DUCT ASSEMBLY OR SET INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Lubricating compound (Liqui-Moly, Grade NV, thread compound)	Lockrey Co, Lubricants Div, Cedar Shores, Southampton, NY 11968

A. Remove Fan Duct Assembly or Fan Duct Set (See Figure 201 or 202)

(1) (Code A) Remove engine wiring harness in accordance with 72-00-02, MAINTENANCE PRACTICES.

(2) Remove fuel heater or oil to cooler tube installation in accordance with 79-20-06, MAINTENANCE PRACTICES.

(3) Remove fuel/oil cooler installation in accordance with 79-20-07, MAINTENANCE PRACTICES.

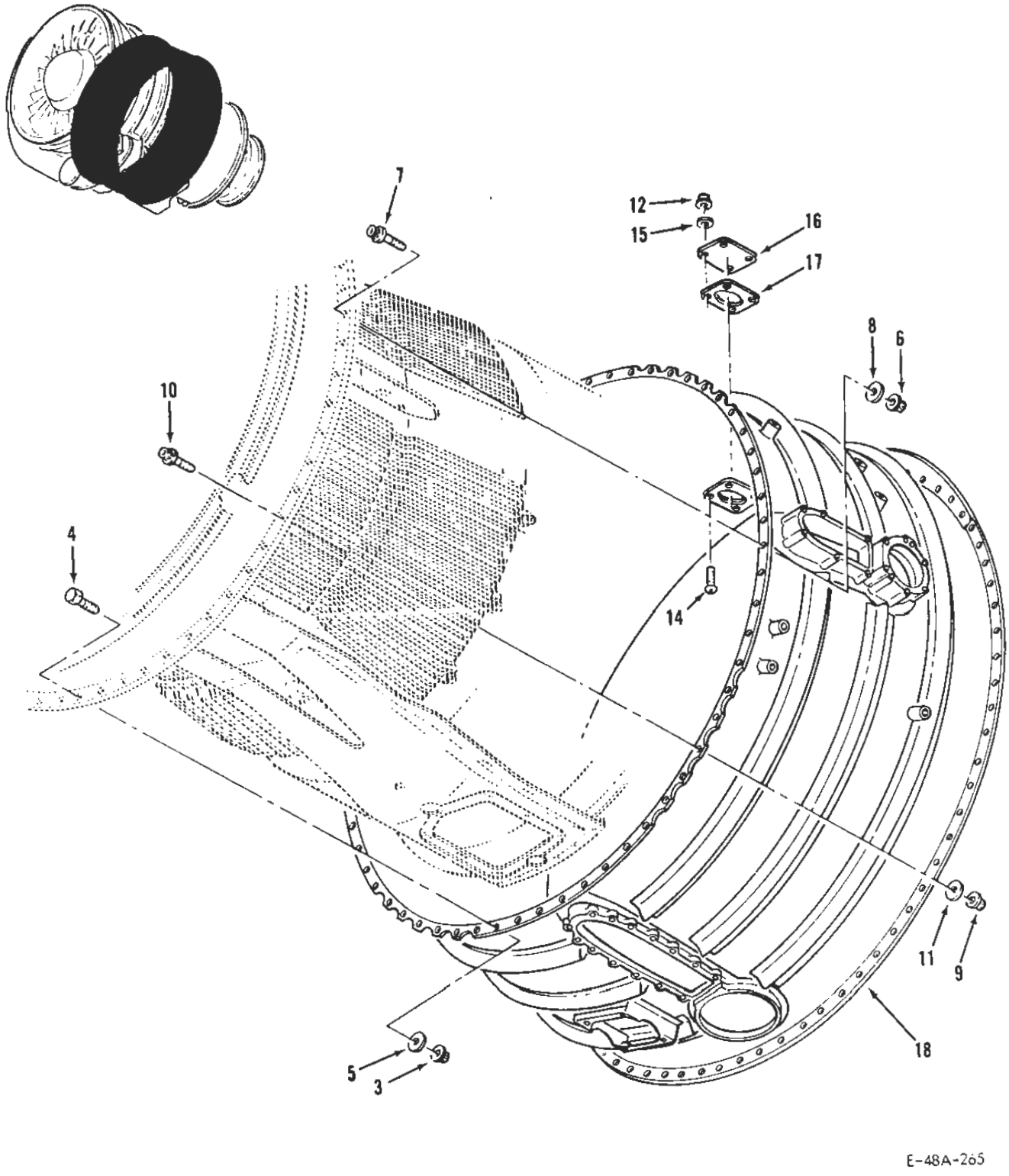
(4) Remove tubes from oil tank to oil pump in accordance with 79-10-01, MAINTENANCE PRACTICES.

(5) Remove fuel and P3 sensing lines installation in accordance with 73-10-02, MAINTENANCE PRACTICES.

(6) Remove oil pump and chip detector installation in accordance with 79-20-03, MAINTENANCE PRACTICES.

(7) Remove fuel system installation in accordance with 73-20-01, MAINTENANCE PRACTICES.

(8) Remove accessory and transfer gearbox installation in accordance with 72-60-01, MAINTENANCE PRACTICES.



(Codes A, B Pre SB72-3040) Fan Duct
Assembly Installation
Figure 201

1. A. (9) Remove ignition unit and remove lockplate and grommet securing igniter leads to fan duct assembly or set in accordance with 74-00-01, MAINTENANCE PRACTICES.

R (10) (Code C) (Codes A, B Pre SB72-3085) Remove anti-ice pressure switch installation in accordance with 75-10-01, MAINTENANCE PRACTICES.

(11) Remove solenoid controller valve and attached tubes in accordance with 76-10-01, MAINTENANCE PRACTICES.

(12) Remove right-side duct, oil-out tube, left-side fairing, and oil inlet tube in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 201.)

(13) Remove bottom duct rib and oil transfer tubes in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 202.)

(14) Remove nuts, washers, screws, and bolts securing fan duct assembly or fan duct set to engine support housing.

(15) Remove bleed air ducts in accordance with 75-10-05, MAINTENANCE PRACTICES, then remove fan duct assembly or fan duct set.

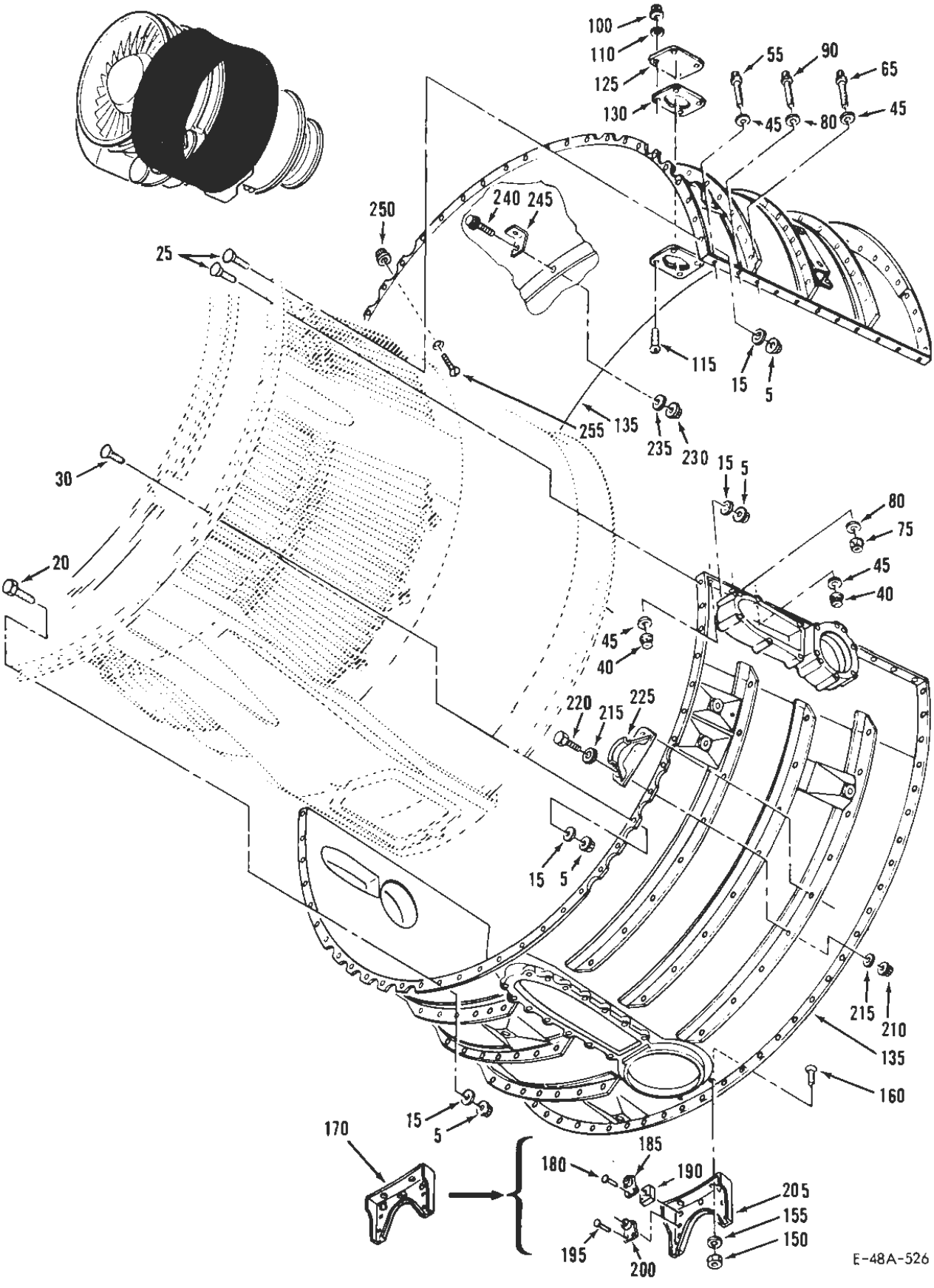
(16) (Post SB72-3040) Remove nuts, washers, and bolts securing sections of fan duct set together and separate upper and lower sections.

R (17) Remove nuts, washers, and screws or bolts securing high pressure bleed air extraction port cover on outer duct, then remove cover and gasket.

KEY TO FIGURE 201

3. NUT (IPC FIG. 19)
4. BOLT
R 5. WASHER
6. NUT
7. SCREW
8. WASHER
9. NUT
10. SCREW
11. WASHER
12. NUT
*14. SCREW OR BOLT
15. WASHER
16. COVER
17. GASKET
18. FAN DUCT ASSY

R *BOLT (PART ADDED)



(Post SB72-3040) Fan Duct Set Installation
Figure 202

1. A. (18) (Code C) Remove nuts, washers, and screws securing fuel meter bracket, then remove fuel meter bracket.

(19) (Code A, Post SB72-3040) Remove nuts, washers, and bolts securing fire detector bracket, then remove fire detector bracket.

(20) (Code A, Post SB72-3040) Remove nut, washer, and bolt securing bracket on upper half of fan duct set, then remove bracket.

(21) (Code C) Remove nut and screw filling hole in top half of fan duct set as required.

KEY TO FIGURE 202

5.	NUT (IPC FIG. 20)	*180.	RIVET
15.	WASHER	*185.	NUTPLATE
20.	BOLT	*190.	SPACER
25.	BOLT	*195.	RIVET
30.	SCREW	*200.	NUTPLATE
40.	NUT	205.	FUEL METER BRACKET
45.	WASHER	210.	NUT (CODE A)
55.	BOLT	215.	WASHER (CODE A)
65.	BOLT	220.	BOLT
75.	NUT	225.	FIRE DETECTOR BRACKET (CODE A)
80.	WASHER		
90.	BOLT	230.	NUT (PART DELETED) (CODE A)
100.	NUT		
110.	WASHER	235.	WASHER (PART DELETED) (CODE A)
R **115.	SCREW OR BOLT		
125.	COVER	240.	BOLT (PART DELETED) (CODE A)
130.	GASKET		
135.	FAN DUCT SET (MATCHED)	245.	BRACKET (PART DELETED) (CODE A)
150.	NUT		
155.	WASHER	250.	NUT (CODE C)
160.	SCREW	255.	BOLT (CODE C)
170.	FUEL METER BRACKET		

*NOT REMOVED AT MAINTENANCE LEVEL
R **BOLT (PART ADDED)

1. B. (Post SB72-3040) Remove Fan Duct Set Upper Half as Follows (See Figure 202)

(1) (Code A) Remove engine wiring harness in accordance with 72-00-02, MAINTENANCE PRACTICES.

(2) Remove ignition unit and remove lockplate and grommet securing igniter leads to fan duct set in accordance with 74-00-01, MAINTENANCE PRACTICES.

R (3) (Code C) (Codes A, B Pre SB72-3085) Remove anti-ice pressure switch installation in accordance with 75-10-01, MAINTENANCE PRACTICES.

(4) Remove solenoid controller valve and attached tubes in accordance with 76-10-01, MAINTENANCE PRACTICES.

(5) Remove nuts, washers, screws, and bolts securing upper half of fan duct set to engine support housing (figure 204).

(6) Remove nuts, washers, and bolts securing halves of fan duct set together and separate upper half (figure 202).

R (7) Remove nuts, washers, and screws or bolts securing high
R pressure bleed air extraction port cover, then remove
R cover and gasket.

C. Install Fan Duct Assembly or Fan Duct Set (See Figure 201 or 202)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) (Code C) Apply a light coat of lubricating compound (Liqui-Moly, Grade NV, thread compound) to threads of screws for fuel meter bracket and install bracket with screws, washers, and nuts. Tighten nuts (150) to torque of 40 inch-pounds.

(2) (Code A Post SB72-3040) Apply a light coat of lubricating compound (Liqui-Moly, Grade NV, thread compound) to threads of bolts for fire detector bracket on lower half of fan duct set and install bracket with nuts, washers, and bolts. Tighten nuts (210) to torque of 40 inch-pounds.

(3) (Code A Post SB72-3040) Apply a light coat of lubricating compound (Liqui-Moly, Grade NV, thread compound) to threads of bolt for bracket on upper half of fan duct set and install bracket with nut, washer, and bolt. Tighten nut (230) to torque of 40 inch-pounds.

set and install bracket with nut, washer, and bolt. Tighten nut (230) to torque of 40 inch-pounds.

1. C. (4) Apply a light coat of lubricating compound (Liqui-Moly, Grade NV, thread compound) to threads of screws for securing high pressure bleed air extraction port cover. Install cover and gasket and secure with nuts, washers, and screws or bolts. Tighten screws (14, figure 201), or screws or bolts (115, figure 202) to torque of 30 inch-pounds. (See figure 202.)

(5) (Post SB72-3040) Apply a light coat of lubricating compound (Liqui-Moly, Grade NV, thread compound) to threads of bolts for attaching halves of fan duct set together. Assemble upper and lower sections of fan duct set together and secure mating flanges with bolts, washers, and nuts. Tighten bolts (55, 65) to torque of 40 inch-pounds. Tighten bolts (90) to torque of 60 inch-pounds.

(6) (Code C) If removed, install screw and nut used to fill hole in top half of fan duct set.

(7) Position fan duct assembly or fan duct set on engine and install bleed air ducts in acccordance with 75-10-05, MAINTENANCE PRACTICES.

(8) (Pre SB72-3040) Install screws, bolts, washers, and nuts securing fan duct assembly to aft flange of engine support housing. Tighten nuts (20, figure 203) to torque of 40 inch-pounds. Tighten bolts (10, 45) to torque of 50 inch-pounds or nuts (5, 40) to torque of 40 inch-pounds.

(9) (Post SB72-3040) Install screws, bolts, washers, and nuts securing fan duct set to aft flange of engine support housing. Tighten nuts (25, figure 204) to torque of 40 inch-pounds. Tighten bolts (15, 60) to torque of 50 inch-pounds or nuts (5, 50) to torque of 40 inch-pounds.

(10) Install bottom duct rib and oil transfer tubes in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 202.)

(11) Install right side duct, oil-out tube, left side fairing and oil inlet tube in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 201)

(12) Install solenoid controller valve and attaching tube assemblies in accordance with 76-10-01, MAINTENANCE PRACTICES.

R 1. C. (13) (Code C) (Codes A, B Pre SB72-3085) Install anti-ice pressure switch installation in accordance with 75-10-01, MAINTENANCE PRACTICES.

(14) Secure igniter leads with grommet and lockplate and install ignition unit in accordance with 74-00-01, MAINTENANCE PRACTICES.

(15) Install accessory and transfer gearbox installation in accordance with 72-60-01, MAINTENANCE PRACTICES.

(16) Install fuel system installation in accordance with 73-20-01, MAINTENACE PRACTICES.

(17) Install oil pump and chip detector installation in accordance with 79-20-03, MAINTENANCE PRACTICES.

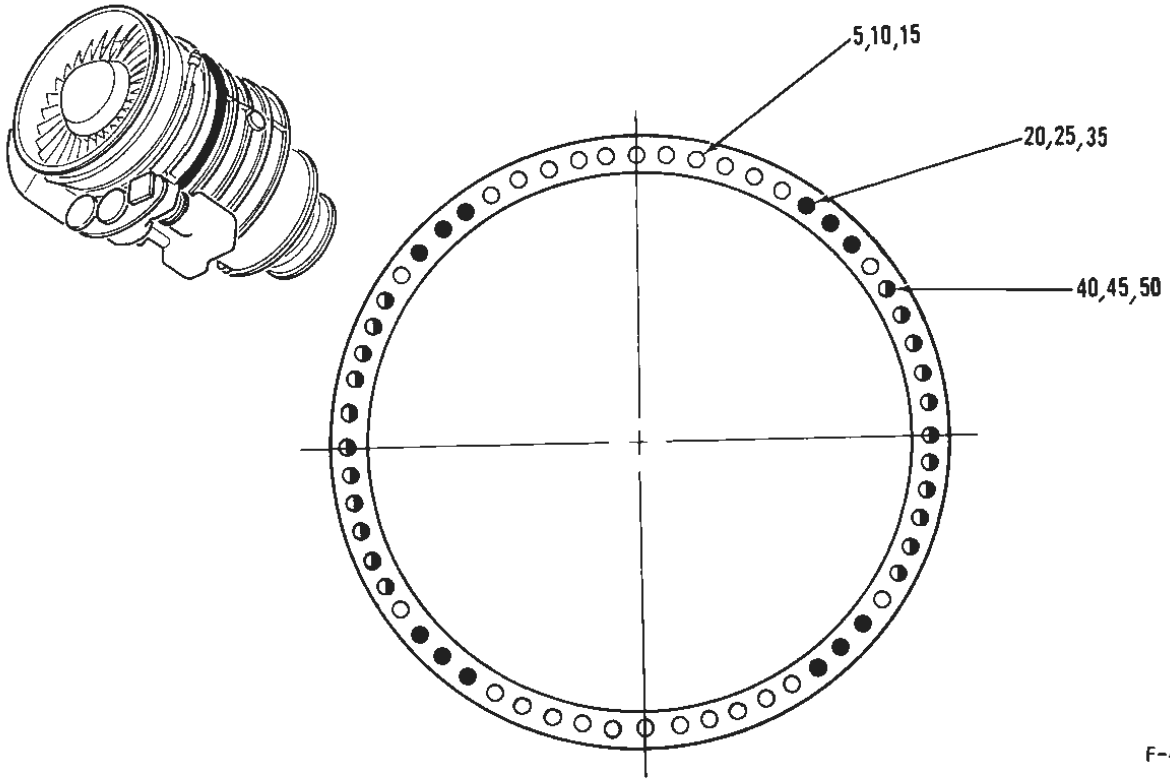
(18) Install fuel and P3 sensing lines installation in accordance with 73-10-02, MAINTENANCE PRACTICES.

(19) Install fuel/oil cooler installation in accordance with 79-20-07, MAINTENANCE PRACTICES.

(20) Install fuel heater or oil to cooler tube installation in accordance with 79-20-06, MAINTENACE PRACTICES.

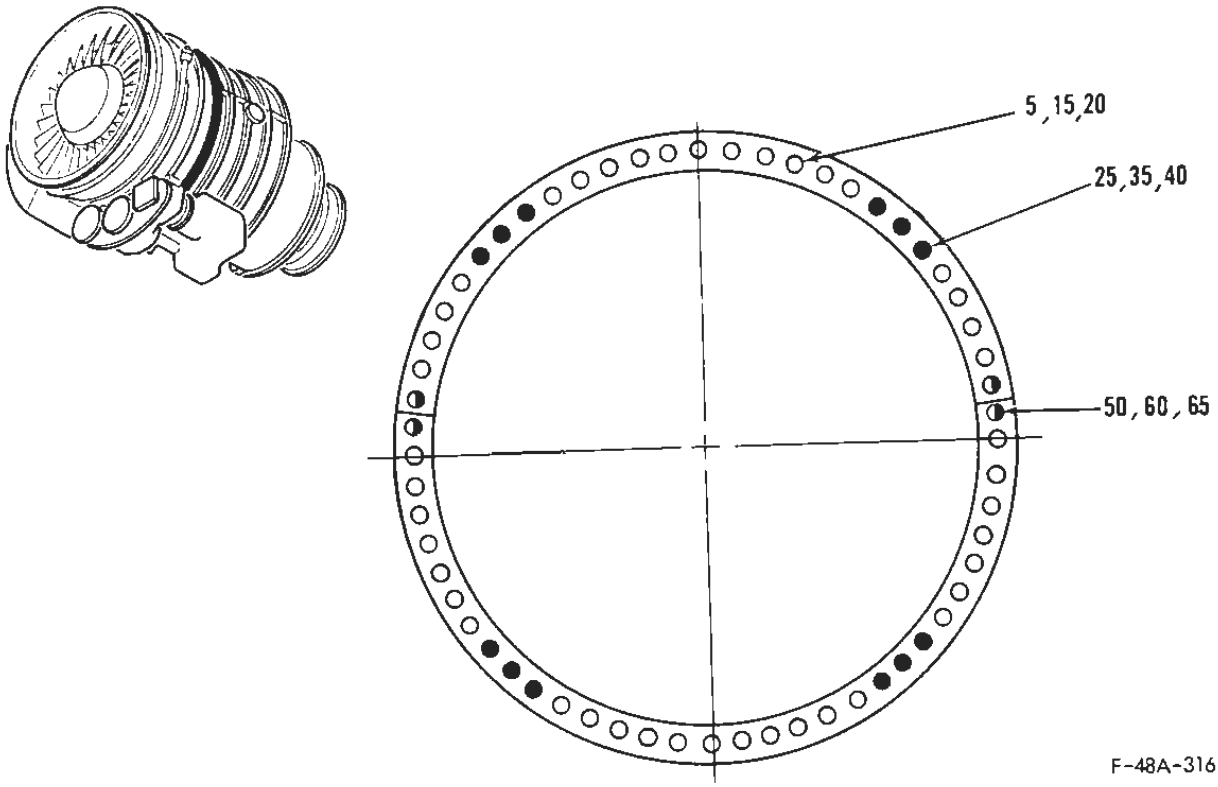
(21) Install tubes from oil tank to oil pump in accordance with 79-10-01, MAINTENANCE PRACTICES.

(22) (Code A) Install engine wiring harness in accordance with 72-00-02 MAINTENANCE PRACTICES.



5. NUT (IPC FIG. 16)
10. BOLT
15. WASHER
20. NUT
25. SCREW
35. WASHER
40. NUT
45. BOLT
50. WASHER

(Codes A, B Pre SB72-3040) Fan Duct Assembly Attaching Hardware Installation
Figure 203



R 5. NUT (IPC FIG. 17)
15. BOLT
20. WASHER
25. NUT
35. SCREW
40. WASHER
50. NUT
60. BOLT
65. WASHER

(Post SB72-3040) Fan Duct Set Attaching Hardware Installation
Figure 204

1. D. (Post SB72-3040) Install Upper Half of Fan Duct Set (See Figure 202)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Position fan duct set upper half on engine.

(2) Apply a light coat of lubricating compound (Liqui-Moly, Grade NV, thread compound) to threads of bolts securing halves of fan duct set together.

(3) Secure mating flanges with bolts, washers, and nuts. Tighten bolts (55, 65, figure 202) to torque of 40 inch-pounds. Tighten bolts (90) to torque of 60 inch-pounds.

(4) (Code C) If removed, install screw and nut used to fill hole in top half of fan duct set.

(5) Install screws, bolts, washers, and nuts securing fan duct set upper half to aft flange of engine support housing. Tighten nuts (25, figure 204) to torque of 40 inch-pounds. Tighten bolts (15, 60) to torque of 50 inch-pounds or nuts (5, 50) to torque of 40 inch-pounds.

(6) (Codes A, B) Install solenoid controller valve and attaching tube assemblies in accordance with 76-10-01, MAINTENANCE PRACTICES.

R (7) (Code C) (Codes A, B Pre SB72-3085) Install anti-ice pressure switch installation in accordance with 75-10-01, MAINTENANCE PRACTICES.

(8) Secure igniter leads with grommet and lockplate and install ignition unit in accordance with 74-00-01, MAINTENANCE PRACTICES.

2. Inspection/Check

A. Inspect Fan Duct Assembly or Fan Duct Set

(1) Inspect for deformation, cracks, or broken welds. Refer to 4, Approved Repairs if damage is indicated.

R (2) Inspect for loose or missing rivets at boss to sheet
R metal interface. Loose or missing rivets not accepta-
R ble; however sheet metal separation at boss casting and
R duct sheet metal is acceptable.

2. A. (3) Inspect flanges and bosses for damage which would affect fit with mating parts. Replace fan duct assembly or set if damage is indicated.

(4) Inspect for damaged paint. If required, touch-up damaged paint in accordance with 3, Cleaning/Painting.

3. Cleaning/Painting

Table 202. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Abrasive paper (Federal Specification P-P-101)	Commercially available
R Color coat (A423-66 Enamel R No. 051 and C1178 Catalyst) R	Griggs Paint, Subsidiary of Domcom Dist, 3602 S 16th Place, Phoenix, AZ 85040
R Primer (P-415-66-611B R and Catalyst C1178-66) R	Griggs Paint, Subsidiary of Domcom Dist, 3602 S 16th Place, Phoenix, AZ 85040

A. Clean Parts

(1) Clean parts as specified in Table 203 in accordance with cleaning methods provided in 72-00-00, GENERAL - CLEANING/PAINTING.

Table 203. Cleaning Methods

Figure No.	Item No.	Nomenclature	Cleaning Methods 1	2	3	4	5	6
All standard metallic hardware			X	X				
201	17	Cover	X	X			X	X
	18	Fan Duct Assy	X	X				
202	125	Cover	X	X			X	X
	135	Fan Duct Set	X	X				
	170	Bracket	X	X				
	205	Bracket	X	X				
	225	Bracket	X	X				

3. B. Touch Up Damaged Painted Surfaces

(1) Touch up bare metal on surfaces with full coat of
R primer (P-415-66-611B and Catalyst C1178-66) as
R follows.

(a) Prepare primer by mixing in equal parts by volume. Allow mixed primer to stand for 30 minutes before application.

(b) Apply one coat of primer by either brushing or spraying.

(c) Air-dry primer for 15 to 30 minutes, then heat-cure with portable hot air gun for one hour at temperature not exceeding 80C (175F).

R (2) Touch up damaged color coat (A423-66 Enamel No. 051 and
R C1178 Catalyst) as follows.

(a) Remove damaged paint and blend edges of damaged paint areas with abrasive paper (Federal Specification P-P-101).

(b) Apply primer to any bare metal as specified in step (1) to thickness of one mil.

R (c) Prepare color coat by mixing A423-66 Enamel No.
R 051 and C1178 Catalyst in equal parts by volume. Allow mixed color coat to stand for 30 minutes before application.

(d) Apply one coat of color coat 2 to 3 mils thick by either brushing or spraying.

(e) Air-dry color coat for 15 to 30 minutes, then heat-cure with portable hot air gun for one hour at temperature not exceeding 80C (175F).

4. Approved Repairs

A. Repair Damaged Fan Duct Skin

(1) If skin is dented or displaced, restore original contour in accordance with good shop practices. Ensure that surface is smooth in flow path of fan duct.

(2) Stop drill any cracks or tears in accordance with good shop practices.

(3) Cover cracks and tears, on external surfaces only, with a patch of similar material (aluminum) of sufficient size to overlap damaged area to allow riveting through undamaged fan duct skin. Attach patch with sufficient quantity of rivets to provide firm attachment with minimum leakage. Perform all repairs in accordance with good shop practices.

FAN SUPPORT ASSEMBLY INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Solvent, Stoddard (Federal Specification P-D-680, Type I)	Commercially available

A. Remove Fan Support Assembly (See Figure 201)

R (1) Remove fan spinner and spinner support installation in
R accordance with 72-70-01, MAINTENANCE PRACTICES.

(2) Remove fan rotor assembly in accordance with 72-70-03, MAINTENANCE PRACTICES.

(3) Remove compressor inlet stator in accordance with 72-20-02, MAINTENANCE PRACTICES.

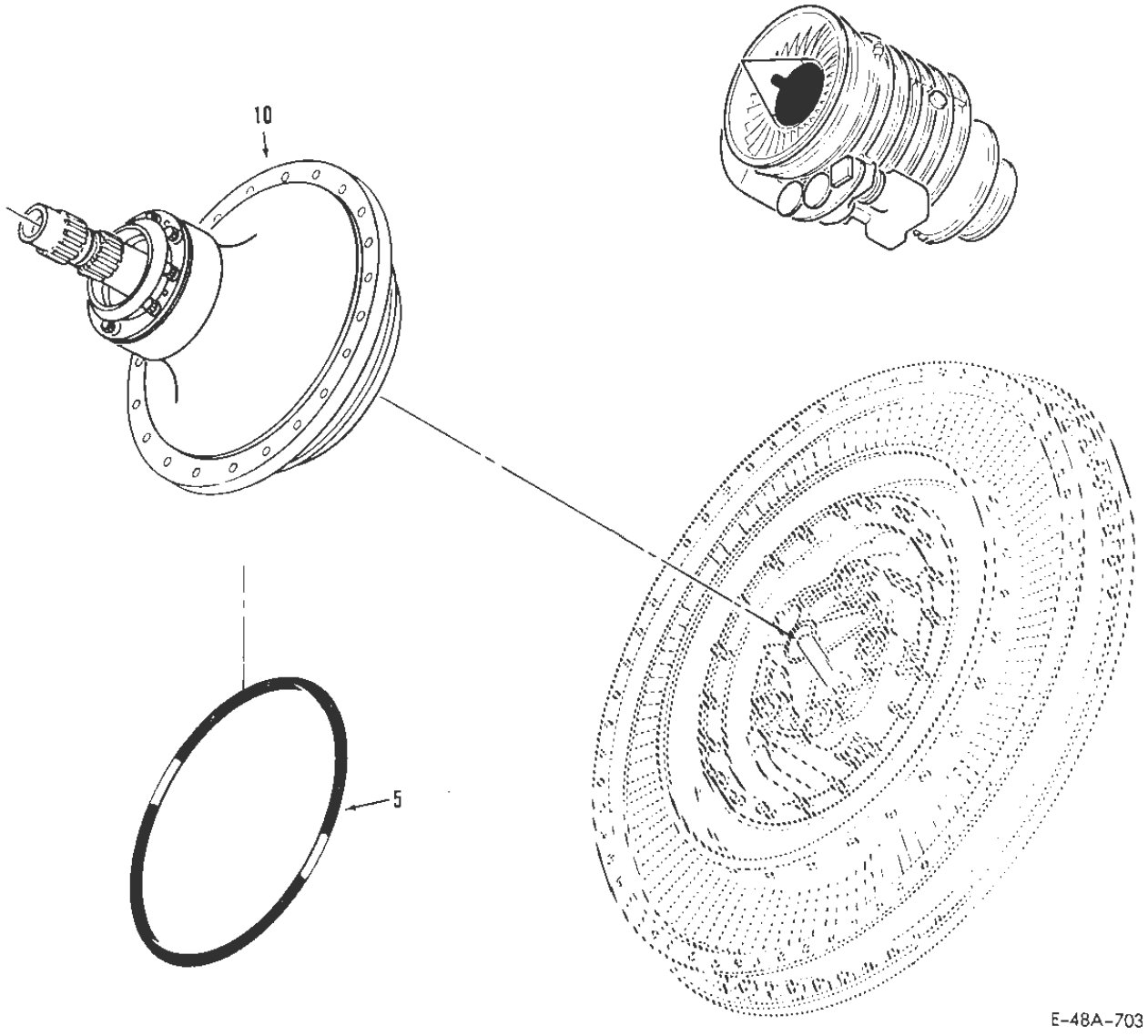
(4) Remove fan support assembly. Remove packing. If unable to manually remove fan support assembly, use 10-32 screws in empty threaded holes of outer bolt circle on housing to force support assembly forward by jackscrews action.

NOTE: Whenever the fan support assembly is removed from the engine, cover the oil scavenge port at the 6 o'clock position in the strut of the intermediate case assembly. This is to ensure that tools or hardware are not accidentally dropped into the opening.

B. Install Fan Support Assembly (See Figure 201)

(1) Install new packing in groove of fan support assembly.

R



5. PACKING (IPC FIG. 77)

10. FAN SUPPORT ASSY

Fan Support Assembly Installation
Figure 201

NOTE: Remove covering from oil scavenge port at the 6 o'clock position in the strut of the intermediate case assembly.

1. B. (2) Wipe face of seal (10, figure 201, 72-71-03) installed in shaft (12)) with solvent, Stoddard (Federal Specification P-D-680, Type I). If required, clean any carbon buildup on face of seal in accordance with 72-71-03, 3, Cleaning/Painting, then install fan support assembly with packing.

(3) Install compressor inlet stator in accordance with 72-20-02, MAINTENANCE PRACTICES.

(4) Install fan rotor assembly in accordance with 72-70-03, MAINTENANCE PRACTICES.

R (5) Install fan spinner and spinner support installation in
R accordance with 72-70-01, MAINTENANCE PRACTICES.

2. Inspection/Check

A. Inspect Fan Support Assembly

(1) Inspect for cracked, loose, or worn components. Replace unserviceable items in accordance with applicable chapter/section/subject (MAINTENANCE PRACTICES, 72-71-01, 72-71-02, or 72-71-03).

(2) Using dental mirror, inspect collars securing ring gear retainer and bolts (figure 201, 72-71-03) for errosion. Any visible erosion requires replacement of bolts and collars. Refer to 72-71-03, MAINTENANCE PRACTICES.

3. Cleaning/Painting

A. Clean Parts

(1) Clean exterior surfaces of fan support assembly in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method No. 1, except limit application of solvent to spraying only.

BY-PASS FAN SUPPORT AND SHAFT SECTION - DESCRIPTION AND OPERATION

1. General

The by-pass fan support and shaft section consists of a fan seal assembly and roller bearing section, fan support, deflector, and fan thrust bearing section, fan shaft assembly and ring gear section.

The section provides the support for the by-pass fan and ring gear section. The fan seal assembly prevents oil from getting into the fan air-flow and the ring gear section drives the fan.

FAN SEAL ASSEMBLY AND ROLLER BEARING - MAINTENANCE PRACTICES

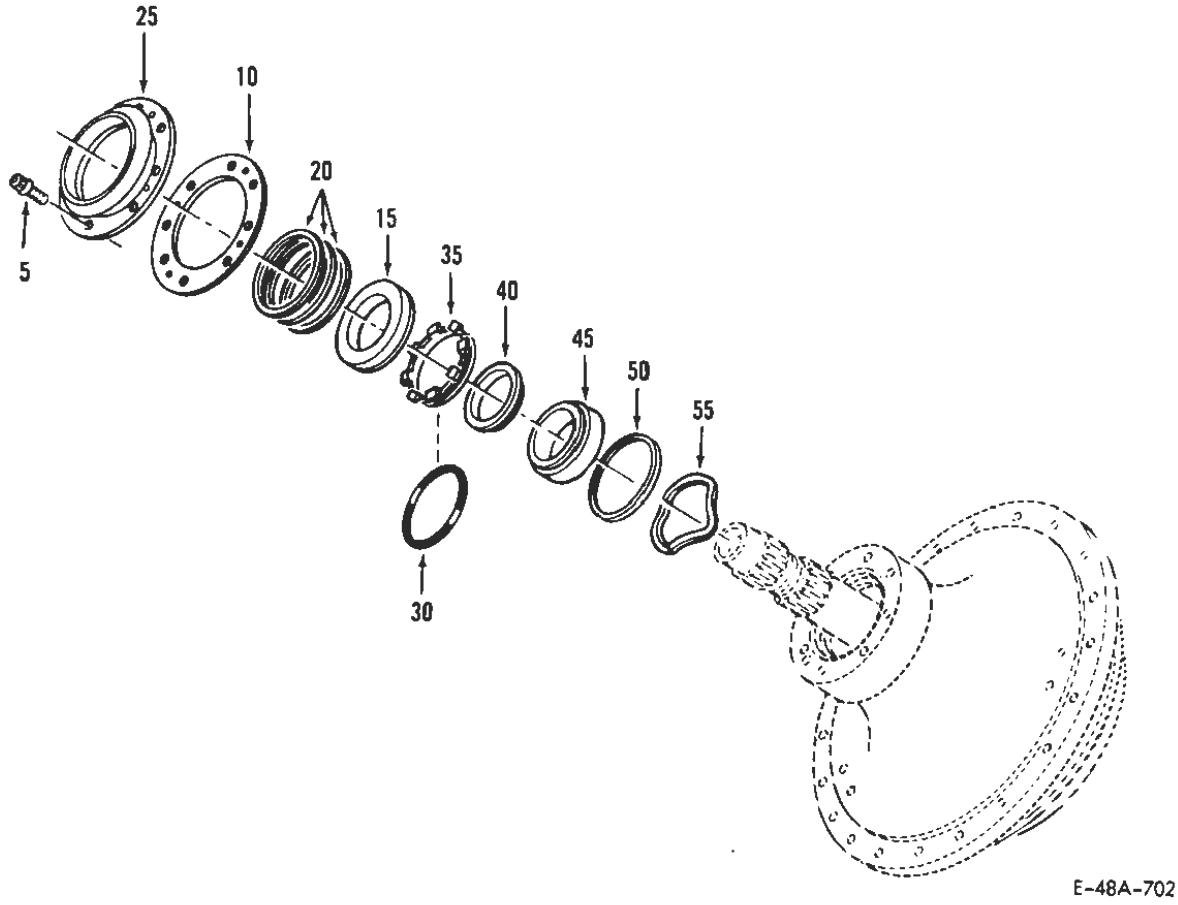
1. Removal/Installation

Table 201. Special Tools, Fixtures and Equipment

Item No.	Nomenclature	Use	Source/ Part No.
NOTE: Equivalent substitutes may be used for listed items.			
1.	Mechanical Bearing Removal Puller	Removes bearing.	289757-1
2.	Bearing Driver	Installs bearing.	289758-1
3.	Fan Shaft Holder	Supports fan shaft for assembly.	289906-1
4.	Installation and Removal Seal Driver	Installs and removes seal.	291268-2

Table 202. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Lubricating compound (Liqui-Moly, Grade NV, Thread Compound)	Lockrey Co, Lubricants Div, Cedar Shores, Southampton, NY 11968
Scouring Pad (red or green Scotch-Brite)	Minnesota Mining and Mfg Co. 3M Center, St. Paul MN 55101



R

R	5.	BOLT (IPC FIG. 78)	35.	SPACER
R	10.	GASKET	40.	SEAL ROTOR
R	15.	NO. 1 FAN CARBON SEAL	45.	ROLLER BEARING
R	20.	SHIM	50.	PLATE
R	25.	SEAL CARRIER	55.	SPRING WASHER
R	30.	PACKING		

Fan Seal Assembly and Roller Bearing
Figure 201

Table 202. Materials and Compounds (Cont)

Material or Compound	Manufacturer
Solvent, Stoddard (Federal Specification P-D-680, Type I)	Commercially available
1,1,1,-Trichloroethane (MIL-T-81533)	Dow Corning Co, S Saginaw Rd, Midland, MI 48640

1. A. Remove Fan Seal Assembly and Roller Bearing (See Figure 201)

R (1) Remove fan spinner and spinner support installation in
R accordance with 75-10-02, MAINTENANCE PRACTICE.

R (2) Remove fan rotor assembly in accordance with 72-70-03, MAINTENANCE PRACTICES.

R (3) Remove compressor inlet stator in accordance with 72-20-02, MAINTENANCE PRACTICES.

R (4) Remove fan support assembly in accordance with 72-70-06, MAINTENANCE PRACTICES.

NOTE: Whenever the fan support assembly is removed from the engine, cover the oil scavenge port at the 6 o'clock position in the strut of the intermediate case assembly. This is to ensure that tools or hardware are not accidentally dropped into the opening.

R (5) Place fan support assembly on 289906-1 holder.

R (6) Remove bolts securing seal carrier to fan support housing. Remove assembled carrier, seal, and shims, then remove gasket.

CAUTION: WHEN PERFORMING THE FOLLOWING STEP, HANDLE SEAL WITH CARE TO AVOID INADVERTANT DISASSEMBLY. SEAL IS PRESSURE CHECKED AS A UNIT AND SHOULD NOT BE DISASSEMBLED IF SEAL IS TO BE REUSED. SEAL COMPONENTS ARE EASILY DAMAGED BY HANDLING.

1. A. (7) Remove No. 1 fan carbon seal as follows.

(a) If seal was previously installed using compound (Loctite 40 or 640, (MIL-R-46082, Type 2)) thermally degrade by heating to 260C (500F).

R (b) Remove seal from seal carrier using 291268-2
R driver, then remove shims noting number and thick-
R ness to aid in reassembly.

R (c) Remove compound, if present, using a scouring pad
R (Scotch-Brite, red or green) and 1,1,1-
R Trichloroethane (MIL-T-81533).

R (8) Remove spacer and seal rotor, then remove packing from
R spacer.

(9) Remove roller bearing using 289757-1 puller. Remove plate and spring washer.

B. Install Fan Seal Assembly and Roller Bearing

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Install spring washer, plate, and roller bearing. Seat roller bearing on shaft using 289758-1 driver.

(2) Wipe face of seal rotor with solvent, Stoddard (Federal Specification P-D-680, Type I), then install seal rotor against bearing race.

NOTE: When taking measurements, ensure that fan support housing is firmly seated against holder and shaft is fully extended through forward side of housing to prevent incorrect measurements due to axial play in the fan thrust bearing. If all original components are reinstalled omit steps (3) through (6) and reinstall thickness of shims removed at disassembly.

1. B. (3) Measure distance from forward face of seal rotor to forward surface of fan support housing. Record as Dimension A. (See figure 202.)

(4) On seal carrier, without gasket installed, measure distance from mating surface for shims to mating surface for gasket. Record as Dimension B. (See figure 202.)

(5) Measure thickness of gasket to be installed. Record as Dimension C. (See figure 202.)

(6) Add Dimensions A, B, C, and 0.004 inch. Subtract 0.666 inch for seal working area. Result is required thickness of shims to be installed, +0.002/-0.002 inch.

R NOTE: Ensure use of support base of 291268-2
R driver to preclude breaking of welds on
R seal carrier.

R (7) Install proper shims, place seal carrier on support
R base of 291268-2 driver then press No. 1 fan carbon seal into seal carrier.

(8) Install gasket on seal carrier. Install new packing on
R spacer, then install spacer. Install seal carrier with
R assembled parts.

(9) Position seal carrier against fan support housing.

CAUTION: PART NUMBER OF BOLTS USED TO ATTACH SEAL CARRIER TO FAN SUPPORT HOUSING IN THE FOLLOWING STEP DETERMINES TORQUE TO BE APPLIED. BOLTS ARE IDENTIFIED ON END OF BOLT HEADS. INCORRECT TORQUE MAY RESULT IN BOLTS BACKING OUT OF FAN SUPPORT HOUSING. ENSURE PROPER TORQUE IS USED AT ASSEMBLY AND BOLTS ARE TIGHTENED SEQUENTIALLY IN INCREMENTS TO SPECIFIED TORQUE VALUE, PLUS RUN-DOWN TORQUE, IN ACCORDANCE WITH THE FOLLOWING STEP.

1. B. (10) Apply lubricating compound (Liqui-Moly, Grade NV, thread compound) to eight bolts. Secure seal carrier to fan support housing with Bolts Part No. 145-131-9007

(identified with H28 on bolt head) and tighten eight bolts (5) to torque of 110 inch-pounds. If Bolts Part No. MS21279-05 (identified with MS number on bolt head) are used, tighten eight bolts (5) to torque of 60 inch-pounds.

NOTE: Remove covering from oil scavenge port at the 6 o'clock position in the strut of the intermediate case assembly.

(11) Install fan support assembly in accordance with 72-70-06, MAINTENANCE PRACTICES.

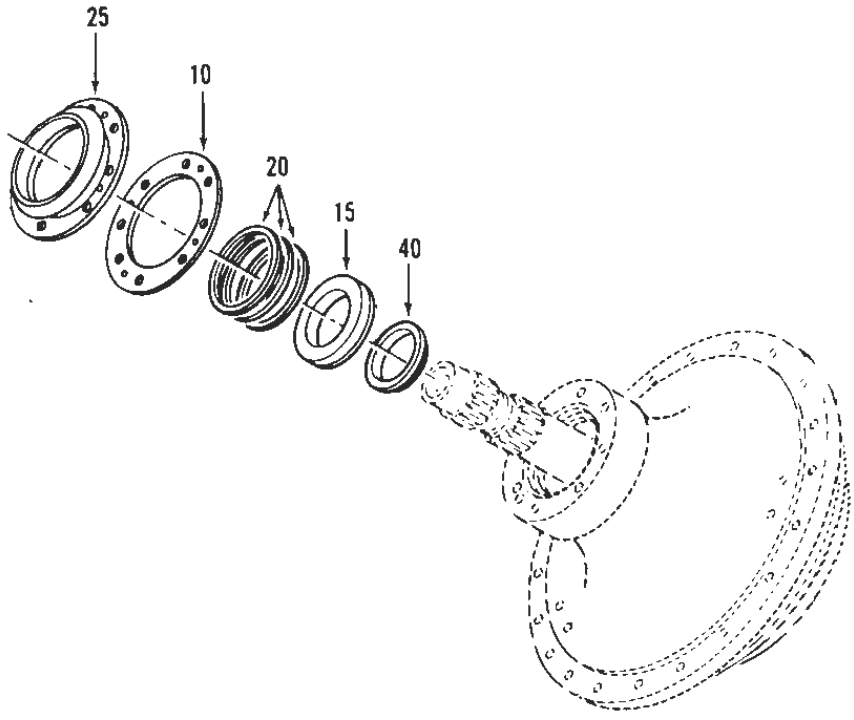
(12) Install compressor inlet stator in accordance with 72-20-02, MAINTENANCE PRACTICES.

(13) Install fan rotor assembly in accordance with 72-70-03, MAINTENANCE PRACTICES.

R (14) Install fan spinner and spinner support installation in
R accordance with 72-70-01, MAINTENANCE PRACTICES.

R KEY TO FIGURE 202

R 10. GASKET (IPC FIG. 78)
R 15. NO. 1 FAN CARBON SEAL
R 20. SHIMS
25. SEAL CARRIER
40. SEAL ROTOR



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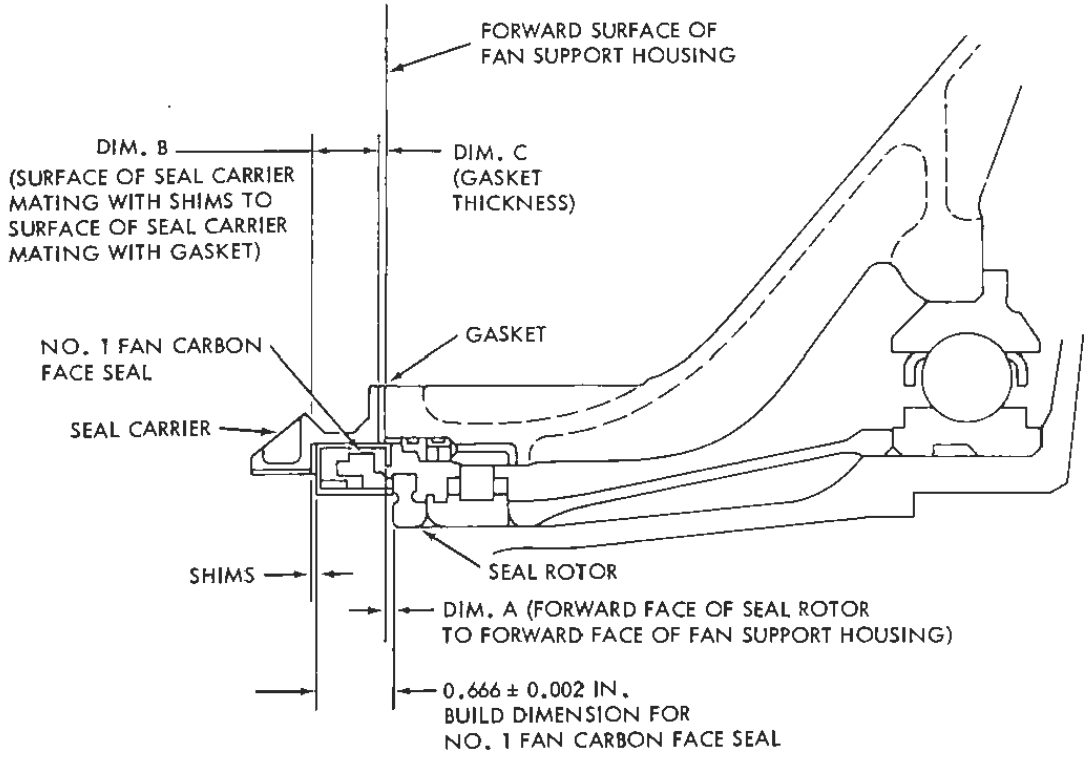

FORWARD SURFACE OF FAN SUPPORT HOUSING
DIM. B (SURFACE OF SEAL CARRIER MATING WITH SHIMS TO SURFACE OF SEAL CARRIER MATING WITH GASKET)
DIM. C (GASKET THICKNESS)
NO. 1 FAN CARBON FACE SEAL
GASKET
SEAL CARRIER
SHIMS
SEAL ROTOR
DIM. A (FORWARD FACE OF SEAL ROTOR TO FORWARD FACE OF FAN SUPPORT HOUSING)
0.666 ± 0.002 IN. BUILD DIMENSION FOR NO. 1 FAN CARBON FACE SEAL

SHIM THICKNESS ±0.002 IN. = A + B + C + 0.004 IN. - 0.666 IN.

E-48A-785

Fan Seal Shim Requirement
Figure 202

2. Inspection/Check

A. Inspect Fan Seal Assembly and Roller Bearing

(1) Inspect seal carrier for contact path, both axially and on circumference, and damage to abradable material. Marked erosion or obliterating tracks are not acceptable. Eccentric grooved patterns in abradable seal area are acceptable but groove depth shall not exceed 0.030 inch. Minimum width of raised area between grooves shall be 0.040 inch.

(2) Inspect seal rotor for the following.

R R (a) Non-uniform contact pattern. Pitted or deteriorated condition of sealing surface, or metal transfer (pickup) onto sealing surface. Nicks, gouges and scratches exceeding 0.0005 inch; any of these conditions is not acceptable. If any crazing can be detected under a strong light by the naked eye, part is not acceptable.

(b) Burrs in clamping area and rotor bore. Burring preventing correct seating is not acceptable.

R (c) If sealing surface is chrome plated, chipping of chrome plating in grooves extending into contact path area is not acceptable.

(3) Inspect roller bearing in accordance with 70-00-00, 7, Bearing Handling and Inspection.

(4) Inspect spacer for wear on face adjacent to bearing outer race. Wear step not exceeding 0.005 inch is acceptable. If wear is excessive, incorrect thickness of shims may have been installed or seal housing may be loose in seal carrier.

(5) Inspect No. 1 fan carbon seal.

(a) Inspect carbon ring for the following.

1) Carbon ring sealing surface wear. Carbon sealing surface height shall be 0.040 inch or more as measured at four points 90 degrees apart.

2) Carbon ring sealing surface damage.

2. A. (5) (a) 2) a) Visually inspect for nicks and chipping. Nicks or chipping shall not extend, either individually or collectively, across more than ten percent of the radial width of the sealing surfaces, nor shall they occupy more than one-eighth of the circumference of either the ID or OD of the sealing surface.

b) Visually inspect for pits. Pits shall not be larger than 0.030 inch across their longest dimension, nor exceed 0.005 inch in depth. Spacing between adjacent edges of pits shall not be less than 0.100 inch.

c) Visually inspect for scratches. Scratches shall not exceed a depth of 0.001 inch or a width of 0.001 inch, nor a length across more than 30 percent of the radial width of the sealing surface. Spacing between adjacent scratches shall not be less than 0.050 inch.

(b) Axial response of carbon ring in assembled seal. Carbon shall readily return to free height when depressed with light even finger pressure over 360 degrees.

R (6) Replace parts that do not meet inspection requirements
R of steps (1) through (5). If seal is replaced, it is
R recommended that mating rotor for seal be replaced.

3. Cleaning/Painting

Table 203. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Scouring pads (red or green Scotch-Brite)	Minnesota Mining and Manufacturing Co, 3M Center, St. Paul, MN 55101
Solvent, Stoddard (Federal Specification P-D-680, Type I)	Commercially available

3. A. Clean Parts

(1) Clean parts as specified in Table 204 in accordance with cleaning methods provided in 72-00-00, GENERAL - CLEANING/PAINTING.

Table 204. Cleaning Methods

	Figure No.	Item No.	Nomenclature	Cleaning Method 1	2	3	4	5	6	7	8	9
	All standard metallic hardware			X	X							
	201	20	Shim	X	X							
R		25	Seal Carrier	X	X							
R		35	Spacer	X	X							
R		40	*Seal Rotor	X	X						X	
R		45	Roller Bearing		X							
R		50	Plate	X	X							
R		55	Spring Washer	X	X							

*Refer to step (2) for alternate cleaning procedure.

(2) Clean seal rotor (figure 201) using alternate procedure.

CAUTION: WHEN PERFORMING THE FOLLOWING STEP, ENSURE SEAL ROTOR IS FLUSHED THOROUGHLY WHILE SCRUBBING TO PREVENT SCORING FACE OF ROTOR WITH CARBON PARTICLES.

(a) Scrub seal rotor with scouring pad (red or green Scotch-Brite) while flushing with solvent, Stoddard (Federal Specification P-D-680, Type I). Flush rotor continuously while scrubbing to wash away carbon particles which may score face of seal rotor.

FAN SUPPORT, DEFLECTOR AND FAN THRUST BEARING - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Special Tools, Fixtures and Equipment

Item No.	Nomenclature	Use	Source/ Part No.
NOTE: Equivalent substitutes may be used for listed items.			
1.	Bearing Removal Driver	Removes bearings.	289760-1
2.	Fan Shaft Holder	Supports fan shaft.	289906-1
3.	Bearing Driver	Installs bearing.	289759-1

A. Remove Fan Support, Deflector, and Fan Thrust Bearing (See Figure 201)

R R (1) Remove fan spinner and spinner support installation in accordance with 72-70-01, MAINTENANCE PRACTICES.

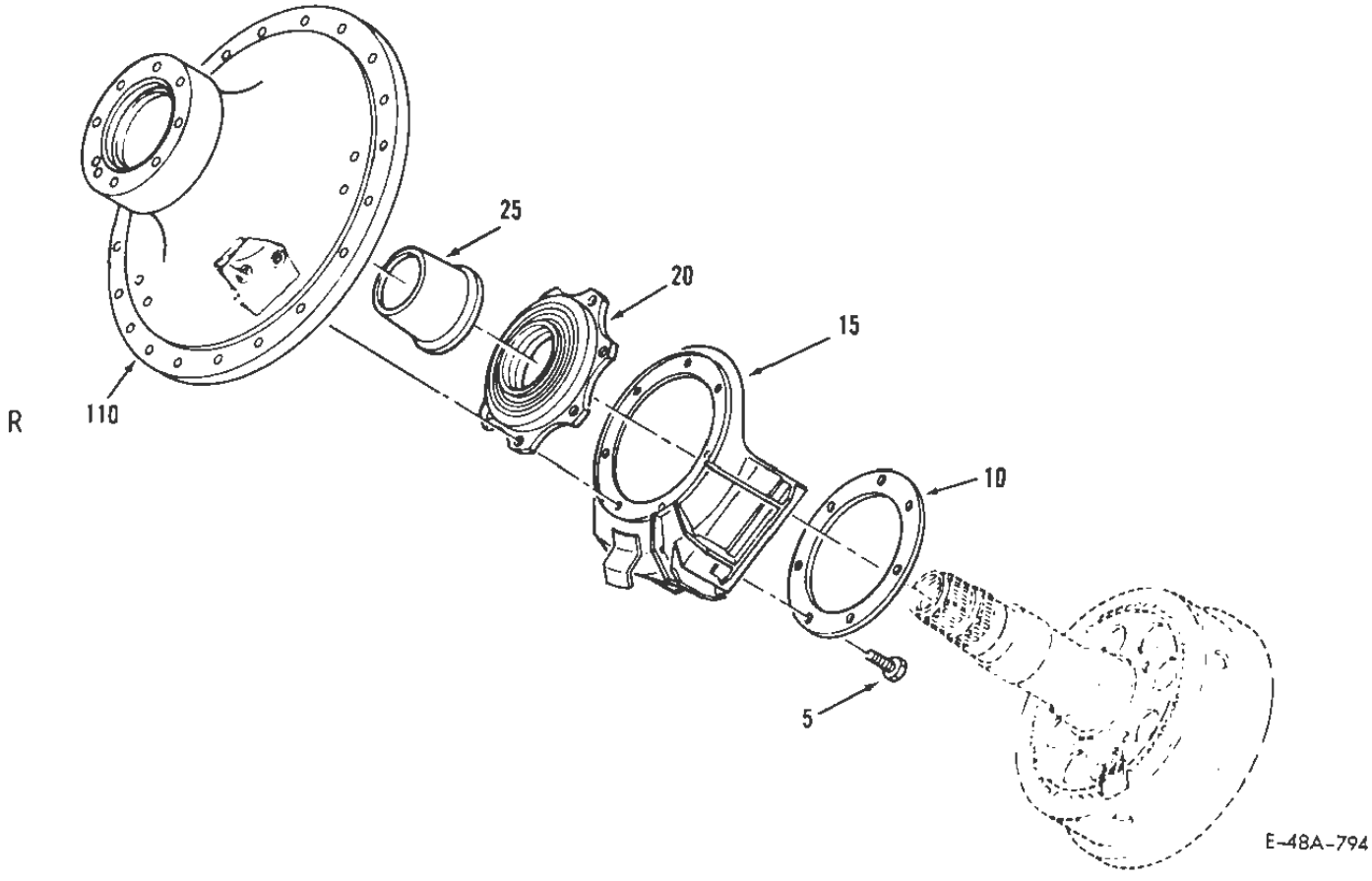
(2) Remove fan rotor assembly in accordance with 72-70-03, MAINTENANCE PRACTICES.

(3) Remove compressor inlet stator in accordance with 72-20-02, MAINTENANCE PRACTICES.

(4) Remove fan support assembly in accordance with 72-70-06, MAINTENANCE PRACTICES.

NOTE: Whenever the fan support assembly is removed from the engine, cover the oil scavenge port at the 6 o'clock position in the strut of the intermediate case assembly. This is to ensure that tools or hardware are not accidentally dropped into the opening.

(5) Remove fan seal assembly and roller bearing in accordance with 72-71-01, MAINTENANCE PRACTICES.



R 5. BOLT (IPC FIG. 80)
R 10. RETAINER
R 15. OIL DEFLECTOR
20. FAN THRUST BEARING
25. SPACER
110. FAN SUPPORT HOUSING

Fan Support, Deflector, and Fan Thrust Bearing
Figure 201

1. A. (6) Remove bolts and fan support housing.

(7) Remove spacer, fan thrust bearing, oil deflector, and retainer from fan shaft assembly and ring gear using 289760-1 driver.

(8) If required, remove oil transfer tubes and jet from fan support housing in accordance with 79-20-10, MAINTENANCE PRACTICES.

B. Install Fan Support, Deflector, and Fan Thrust Bearing (See Figure 201)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

R R (1) If removed, install oil transfer tubes and jet on fan support housing in accordance with 79-20-10, MAINTENANCE PRACTICES.

(2) Place fan shaft in fan shaft 289906-1 holder.

R (3) Install retainer on shaft. Position oil deflector on flange portion of shaft.

(4) Using 289759-1 driver press fan thrust bearing (with grooved inner ring (groove on ID) of split inner race R toward front of shaft) onto shaft, bottoming bearing on shoulder of shaft.

(5) Install spacer on shaft. Install fan support housing on assembly. Orient tab on aft extension of oil deflector at 6 o'clock position of support housing.

(6) Using access holes in flange of shaft assembly, align support housing on shaft with guide pin through oil deflector, fan thrust bearing, and fan support housing and install bolts. Tighten bolts (5) to torque of 100 inch-pounds.

(7) Install fan seal assembly and roller bearing in accordance with 72-71-01, MAINTENANCE PRACTICES.

NOTE: Remove covering from oil scavenge port at the 6 o'clock position in the strut of the intermediate case assembly.

(8) Install fan support assembly in accordance with 72-70-06, MAINTENANCE PRACTICES.

1. B. (9) Install compressor inlet stator in accordance with 72-20-02, MAINTENANCE PRACTICES.

(10) Install fan rotor assembly in accordance with 72-70-03, MAINTENANCE PRACTICES.

R R (11) Install fan spinner and spinner support installation in accordance with 72-70-01, MAINTENANCE PRACTICES.

2. Inspection/Check

A. Inspect Fan Support, Deflector, and Fan Thrust Bearing

(1) Inspect fan thrust bearing in accordance with 70-00-00, 7, Bearing Handling and Inspection.

(2) Inspect oil deflector for cracks (particularly in location of deflector tray attachment) and excessive fretting where deflector contacts fan support.

R (3) Inspect fan support housing assembly for cracks. No cracks are acceptable.

(4) Replace items that do not meet inspection requirements of steps (1) through (3).

3. Cleaning/Painting

A. Clean Parts

(1) Clean all standard metallic hardware in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method No. 1 and 2.

R (2) Clean retainer, oil deflector, spacer and fan support housing in accordance with Cleaning Method No. 2.

R R (3) Clean fan thrust bearing in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, paragraph 1.D.(1).

FAN SHAFT ASSEMBLY AND RING GEAR - MAINTENANCE PRACTICES

1. Removal/Installation

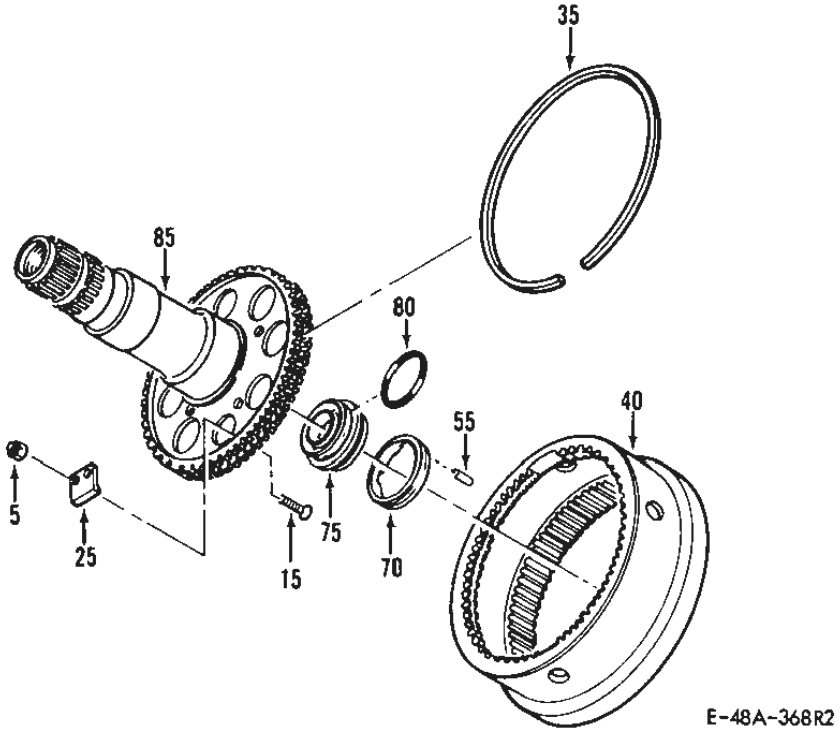
Table 201. Special Tools, Fixtures and Equipment

Item No.	Nomenclature	Use	Source/ Part No.
NOTE: Equivalent substitutes may be used for listed items.			
1.	Fan Shaft Holder	Supports fan shaft.	289906-1
2.	Pneumatic Tool	Installs lock bolts.	Model 353, Huck Mfg Co, 2500 Bellevue Ave, Detroit, MI
R 3.	Adapter	Installs lock bolts.	102463, Huck Mfg Co, 2500 Bellevue Ave, Detroit, MI
R 4.	Nose Assembly	Installs lock bolts.	99-626, Huck Mfg Co, 2500 Bellevue Ave, Detroit, MI

R A. Remove Fan Shaft Assembly and Ring Gear (See Figure 201 or
R 202)

R (1) Remove fan spinner and spinner support installation in
R accordance with 72-70-01, MAINTENANCE PRACTICES.

R



R 5. COLLAR (IPC FIG. 81)
R 15. LOCK BOLT
R 25. RING GEAR RETAINER
R 35. RETAINER RING
R 40. RING GEAR

*55. PIN
*70. NUT
*75. SEAL
*80. PACKING
85. FAN SHAFT

*REMOVE ONLY FOR REPAIR

R (Code C) (Codes A, B Pre SB72-3085)
Fan Shaft Assembly and Ring Gear
Figure 201

1. A. (2) Remove fan rotor assembly in accordance with 72-70-03, MAINTENANCE PRACTICES.

(3) Remove compressor inlet stator in accordance with 72-20-02, MAINTENANCE PRACTICES.

(4) Remove fan support assembly in accordance with 72-70-06, MAINTENANCE PRACTICES.

NOTE: Whenever the fan support assembly is removed from the engine, cover the oil scavenge port at the 6 o'clock position in the strut of the intermediate case assembly. This is to ensure that tools or hardware are not accidentally dropped into the opening.

(5) Remove fan seal assembly and roller bearing in accordance with 72-71-01, MAINTENANCE PRACTICES.

(6) Remove fan support, deflector, and fan thrust bearing in accordance with 72-71-02, MAINTENANCE PRACTICES.

(7) Place fan shaft assembly in fan shaft 289906-1 holder.

NOTE: Record of cycles as specified in Service Bulletin 72-3001 shall be maintained on fan shaft of fan shaft assembly throughout life of part.

(8) Remove collars, lock bolts, ring gear retainer, retainer ring, and ring gear from fan shaft.

B. Install Fan Shaft Assembly and Ring Gear (See Figure 201 or 202)

(1) Install retainer ring in groove in teeth of fan shaft with gap between ring ends adjacent to the two lock bolt holes.

NOTE: When a replacement ring gear is installed, SOAP samples are required to establish a new baseline for subsequent SOAP checks. Refer to 72-00-00, GENERAL - INSPECTION/CHECK.

(2) Position ring gear on assembled fan shaft and retainer ring with spline cutout groove aligned with lock bolt holes in fan shaft.

(3) Install ring gear retainer with tang protruding into spline cutout groove between ring ends and bolt holes aligned with bolt holes in fan shaft. Install lock

R bolts and collars using Model 353 pneumatic tool with
R 102463 adapter, and 99-626 nose assembly.

1. B. (4) Install fan support, deflector, and fan thrust bearing in accordance with 72-71-02, MAINTENANCE PRACTICES.

(5) Install fan seal assembly and roller bearing in accordance with 72-71-01, MAINTENANCE PRACTICES.

(6) Install fan support assembly in accordance with 72-70-06, MAINTENANCE PRACTICES.

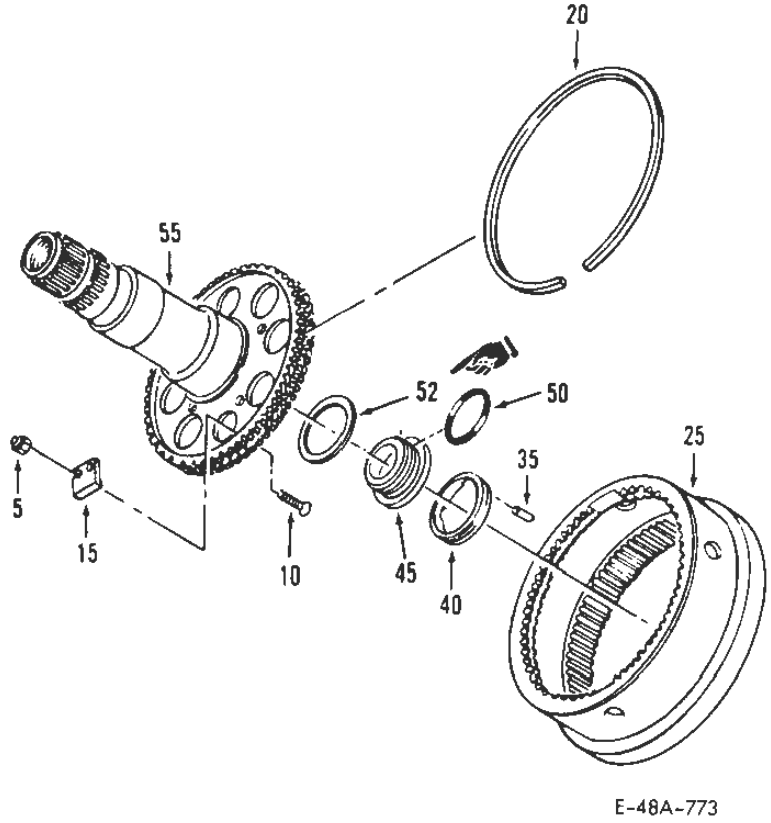
(7) Install compressor inlet stator in accordance with 72-20-02, MAINTENANCE PRACTICES.

NOTE: Remove covering from oil scavenge port at the 6 o'clock position in the strut of the intermediate case assembly.

(8) Install fan rotor assembly in accordance with 72-70-03, MAINTENANCE PRACTICES.

R (9) Install fan spinner and spinner support installation in
R accordance with 72-70-01, MAINTENANCE PRACTICES.

R



R 5. COLLAR (IPC FIG. 81A)
R 10. LOCK BOLT
R 15. RING GEAR RETAINER
R 20. RETAINER RING
R 25. RING GEAR
40. NUT
45. PLUG
50. PACKING
52. GASKET (PN 3072919-1)
55. FAN SHAFT

R (Codes A, B Post SB72-3085)
R Fan Shaft Assembly and Ring Gear
R Figure 202

2. Inspection/Check

A. Inspect Fan Shaft and Ring Gear

(1) Inspect fan shaft and ring gear for wear and pitting on spline teeth. Wear step near roots of teeth shall not exceed 0.002 inch. Maximum depth of any pit shall not exceed 0.020 inch.

(2) Inspect gear teeth on ring gear for area of high polish at either end near root, pitting scoring, or excessive wear. Areas of high polish shall not exceed 0.050 by 0.150 inch. Dimension of any pit shall not exceed 0.010 inch. Number of pits in any circle of 0.250 inch diameter shall not exceed three. Unusual wear is not acceptable. Depth of any scoring or wear shall not exceed 0.002 inch; 90 percent of original tooth surface finish must be visible.

R (3) (Code C) (Codes A, B Pre SB72-3085) Inspect knife-edges on seal for wear. Wear is acceptable if outside diameter of all knife-edge blades is no less than 1.145 inches.

R (4) (Code C) (Codes A, B Pre SB72-3085) Thoroughly clean face of seal (in bore of fan shaft) which mates with anti-ice seal in accordance with 3, Cleaning/Painting to remove all carbon buildup, then inspect face of seal for the following. If required, replace seal in accordance with 4, Approved Repairs.

(a) Non-uniform contact pattern; pitted or deteriorated condition of chrome plate or pickup; nicks, gouges, and scratches exceeding 0.0005 inch: any of these conditions is not acceptable. If any crazing can be detected under a strong light by the naked eye, part is not acceptable.

(b) Burrs in clamping area and rotor bore. Burring preventing correct seating is not acceptable.

(c) Chipping of chrome plating in grooves extending into contact path is not acceptable.

R (5) (Codes A, B Post SB72-3085) Inspect fan shaft and fan
R spinner for evidence of oil leakage. If oil is present
R replace plug in accordance with 4, Approved Repairs.

(6) Replace items that do not meet inspection requirements of steps (1) through (3).

2. A. (/) If maintenance being performed does not require removal of bolts and collars from ring gear retainer, inspect collars for erosion. Any visible erosion requires replacement of bolts and collars. Refer to 1, Removal/Installation.

3. Cleaning/Painting

Table 202. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Scouring pads (red or green Scotch-Brite)	Minnesota Mining and Manufacturing Co, 3M Center, St. Paul, MN 55101
Solvent, Stoddard (Federal Specification P-D-680, Type I)	Commercially available

A. Clean Parts

(1) Clean all standard metallic hardware in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method No. 1 or 2.

(2) Clean retainer ring and ring gear in accordance with 72-00-DO, GENERAL - CLEANING/PAINTING, Cleaning Method 2.

(3) Clean fan shaft assembly.

(a) Mask or plug ends of fan shaft to protect internal components from cleaning agent.

(b) Clean exterior of fan shaft assembly in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method No. 2, except limit cleaning cycle as required to protect internal fan shaft components from cleaning agent.

CAUTION: ENSURE NO CARBON PARTICLES OR FOREIGN MATTER IS WASHED INTO INTERNAL PORTION OF FAN SHAFT WHEN PERFORMING THE FOLLOWING STEP. FLUSH FACE OF SEAL INSTALLED IN FAN SHAFT CONTINUOUSLY WHILE SCRUBBING SEAL FACE TO PREVENT SCORING BY CARBON PARTICLES.

R 3. A. (3) (c) (Code C) (Codes A, B Pre SB72-3085) Scrub face of seal (figure 201) which mates with anti-ice seal
R (figure 201, 72-72-01) with scouring pad (red or green Scotch-Brite) while flushing with solvent, Stoddard (Federal Specification P-D-680, Type I). Flush seal face continuously while scrubbing to wash away carbon particles which may score face of rotor.

4. Approved Repairs

Table 203. Special Tools, Fixtures and Equipment

Item No.	Nomenclature	Use	Source/ Part No.
NOTE: Equivalent substitutes may be used for listed items.			
1.	Fixed Depth Gage	Measures depth of drilled hole.	287463-5-1
2.	Fixed Depth Gage	Measures depth of drilled hole.	287463-6-1
3.	Torquing and Drilling Fixture	Supports fan shaft during drilling and assembly operation.	289928-1
4.	Torque Wrench Adapter	Adapts nut for standard wrench.	289929-1
5.	Leak Test Plug Set	To allow checking leakage of seal or plug in internal bore of fan shaft.	294438-1

Table 204. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Fluid (Sherlock 5 Second Leak Detector, Type I)	Puritan Zep Corp, Aerospace Systems Div, 111 Penn St, El Segundo, CA

R 4. A. Replace Seal or Plug (See Figure 201 or 202)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Install fan shaft with assembled parts in 289928-1 fixture. Install drill plate of 289928-1 fixture and drill out pin securing nut using 0.0625 inch diameter drill. Drill to depth of 0.380 inch to ensure complete removal of pin.

(2) Remove drill plate of 289928-1 fixture. Remove nut using 289928-1 fixture and 289929-1 torque wrench adapter.

R (3) (Code C) (Codes A, B Pre SB72-3085) Remove seal with
R packing from fan shaft.

R (4) (Codes A, B Post SB72-3085) Remove plug with packing
R and gasket from fan shaft. Remove packing and gasket
R from plug.

R (5) (Code C) (Codes A, B Pre SB72-3085) Install packing on replacement seal and install seal with packing in fan shaft.

R (6) (Codes A, B Post SB72-3085) Install gasket and packing
R on replacement plug, then install plug with packing and
R gasket in fan shaft.

NOTE: Number of previously drilled pin holes in fan shaft shall not exceed 14. Number of previously drilled pin holes in nut shall not exceed seven.

(7) Install nut and tighten to torque of 1000 inch-pounds using 289929-1 torque wrench adapter.

4. A. (8) Locate assembled parts on 289928-1 fixture and install fixture drill plate to allow drilling new hole for pin. Location for new hole shall be at least 0.20 inch from any existing hole (from previous pinning operations) in fan shaft.

(9) Drill 0.0620 to 0.0625 inch diameter hole into threads of fan shaft and nut to a depth of 0.30 to 0.33 inch from bottom of spanner slot. Check depth of drilled hole using 287463-5-1 and 287463-6-1 gages.

(10) Press pin to bottom of hole drilled in previous step and stake center of pin using 285748-1-1 punch.

(11) Remove stylus from 285748-1-1 punch and install 294681-1 adapter in place of removed stylus.

(12) Use teflon sheeting to protect fan shaft material at perimeter of pin, stake nut at edge of pin using 285748-1-1 punch and 294681-1 adapter. Ensure nut material is displaced to secure pin and that fan shaft material is not damaged by staking operation.

(13) Remove 294681-1 adapter from 285748-1-1 punch and install stylus removed in step (9).

(14) Remove fan shaft with assembled parts from 289928-1 fixture.

R (15) (Code C) (Codes A, B Pre SB72-3085) Check for leakage past packing installed between seal and fan shaft as follows.

(a) Pass rod and stopper detail of 294438-1 plug set through forward-end bore of fan shaft to seat stopper in internal bore of seal.

R (b) Thread shoulder plug of 294438-1 leak test plug
R set into forward end of fan shaft.

(c) Apply 10 psig regulated air pressure at fitting on shoulder plug.

(d) Position fan shaft with forward end down and fill slot between seal and fan shaft with fluid (Sherlock 5 Second Leak Detector, Type I).

(e) Check for foaming or bubbles in fluid, indicating leakage past packing. No foaming or bubbles are allowed in slot between seal and fan shaft. (Minute leakage at internal diameters of seal is permissible.) If any leakage past packing is evident, packing shall be replaced.

4. A. (15) (f) Shutoff air supply to 294438-1 plug set. Bleed off air pressure from fan shaft and remove plug set.

R (16) (Codes A, B Post SB72-3085) Check for leakage past
R packing and gasket installed between plug and fan shaft
R as follows.

R (a) Thread shoulder plug of 294438-1 leak test plug
R set into forward end of fan shaft.

R (b) Apply ten psig regulated air pressure at fitting
R on shoulder plug.

R (c) Position fan shaft with forward end down and fill
R slot between plug and fan shaft with fluid
R (Sherlock 5 Second Leak Detector, Type 1).

R (d) Check for foaming or bubbles in fluid, indicating
R leakage past packing and gasket. No foaming or
R bubbles are allowed.

R (e) Shutoff air supply to 294438-1 leak test plug set.
R Bleed off air pressure from fan shaft and remove
R plug set.

BY-PASS REDUCTION GEAR SECTION - DESCRIPTION AND OPERATION

1. General

R The by-pass fan reduction gear section consists of the planet
R gear assembly, pinion gear, anti-ic seal and seal support/lubricating nozzle and nozzle support, and coupling shaft assembly.

The section provides gears that mesh with the ring gear driving the fan, resulting in a fan speed slightly higher than 50 percent of N1.

R ANTI-ICE SEAL AND SEAL SUPPORT/LUBRICATING
R NOZZLE AND NOZZLE SUPPORT - MAINTENANCE PRACTICES

R 1. Removal/Installation

R Table 201. Special Tools, Fixtures and Equipment
R

R Item No.	Nomenclature	Use	Source/ Part No.
R NOTE: Equivalent substitutes may be used for listed items.			
R 1.	Anti-Ice Seal Support Holder	Holds support.	291144-1
R 2.	Seal Mechanical Puller	removes seal.	291145-1
R 3.	Seal Driver	Installs seal.	291146-1

R Table 202. Materials and Compounds
R

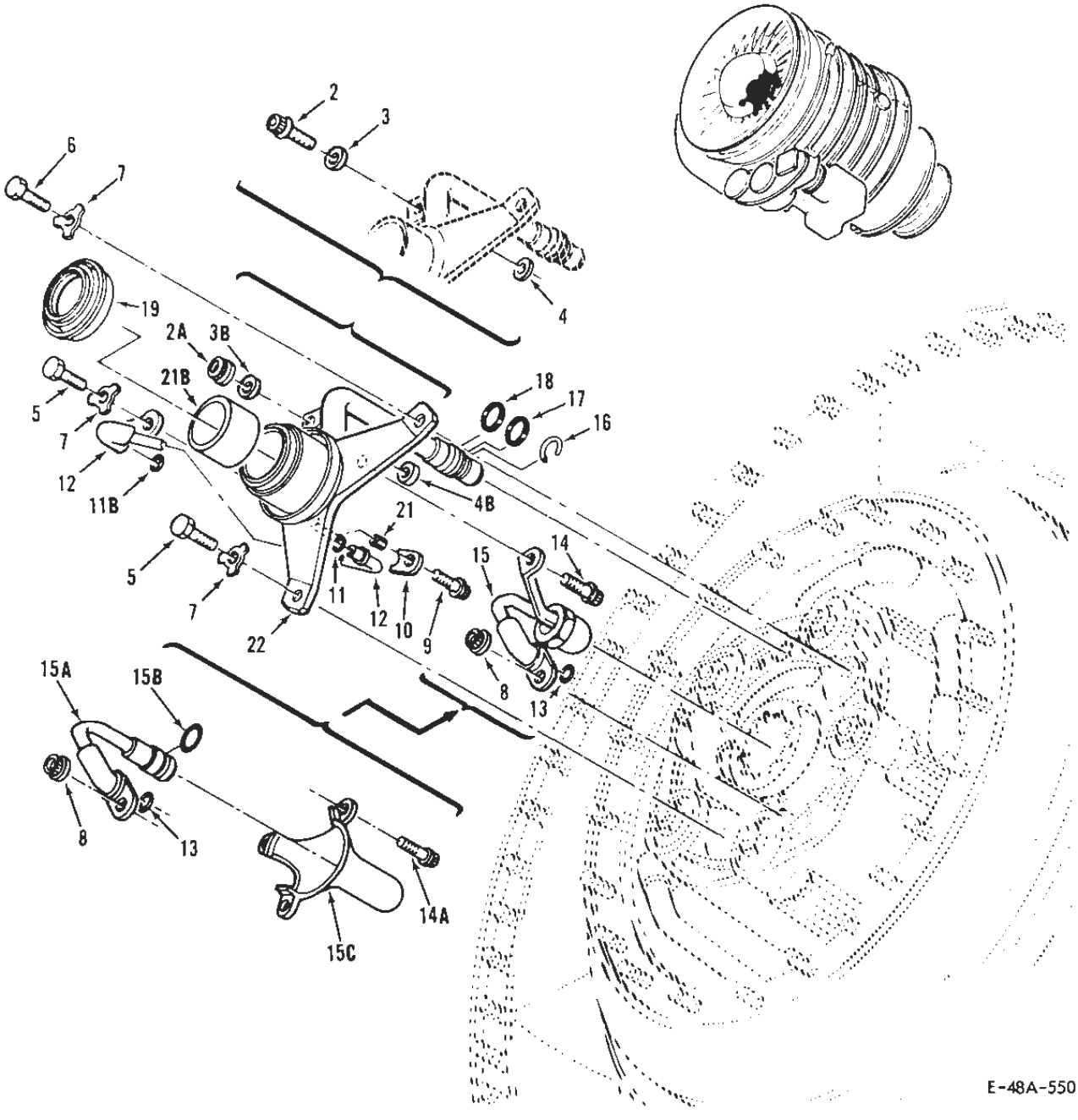
R Material or Compound	Manufacturer
R NOTE: Equivalent substitutes may be used for listed items.	
R Compound (Loctite 40 or 640 R (MIL-R-46082, Type 2))	Loctite Copr, 705 N Mountain Rd, Newington, CT 06111
R Primer (MIL-L-22473, R Grade T)	Loctite Corp, 705 N Mountain Rd, Newington, CT 06111
R 1,1,1-Trichloroethane R (MIL-T-81533)	Dow Corning Corp, S Saginaw Rd, Midland, MI 48650

R A. (Code C) (Codes A, B Pre SB72-3085) Remove Anti-Ice Seal R and Seal Support (See Figure 201)

R (1) Remove fan spinner and spinner support installation in R accordance with 72-70-01, MAINTENANCE PRACTICES.

R (2) Remove fan rotor assembly in accordance with 72-70-03, R MAINTENANCE PRACTICES.

R



R (Code C) (Codes A, B Pre SB72-3085)
Anti-Ice Seal and Seal Support
Figure 201

R 1. A. (3) Remove compressor inlet stator in accordance with 72-20-02, MAINTENANCE PRACTICES.

(4) Remove fan support assembly in accordance with 72-70-06, MAINTENANCE PRACTICES.

NOTE: Whenever the fan support assembly is removed from the engine, cover the oil scavenge port at the 6 o'clock position in the strut of the intermediate case assembly. This is to ensure that tools or hardware are not accidentally dropped into the opening.

(5) Remove nut securing oil jet or tube assembly to engine.

(6) (Installations incorporating Planet Carrier Part No. 3071624-3) Remove screw and washers used to secure welded tab of tubing of seal support.

(7) (Installations incorporating Planet Carrier Part No. 3071624-6 or 3071624-7) Remove nut, washer, and spacer used to secure welded tab of tubing of seal support.

(8) Remove bolts and locking washers securing seal support to engine. Remove assembled anti-ice seal and seal support.

KEY TO FIGURE 201

2.	SCREW	13.	PACKING
2A.	NUT	14.	BOLT
3.	WASHER	14A.	BOLT
3B.	WASHER	15.	OIL JET
4.	WASHER	15A.	TUBE ASSY
4B.	SPACER	15B.	PACKING
5.	BOLT	15C.	LUBRICATING NOZZLE
6.	BOLT	16.	RETAINING RING
7.	LOCKING WASHER	17.	PACKING
8.	NUT	18.	PACKING
9.	BOLT	19.	FACE BELLOWS SEAL (ANTI-ICE)
10.	TUBE RETAINER	* 21.	INSERT
11.	PACKING	*21B.	SEAL SUPPORT LINER
11B.	PACKING	22.	SEAL SUPPORT
12.	BUFFERED AIR TUBE		

*NOT REMOVED AT MAINTENANCE LEVEL

R 1. A. (9) Remove bolt(s) securing oil jet or lubricating nozzle to seal support and remove oil jet or lubricating nozzle with tube assembly. If applicable, remove tube assembly from lubricating nozzle. Remove packing(s) from oil jet or tube assembly.

R (10) Remove bolt and tube retainer securing buffered air tube to seal support. Remove air tube, then remove packings.

R (11) Install 291145-1 puller on seal support and remove anti-ice seal. If seal was previously installed in seal support with compound (Loctite 40 or 640 (MIL-R-46082, Type 2)), remove all compound residue from seal and seal support.

R B. Install Anti-Ice Seal Support (See Figure 201)

R NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

R (1) Install anti-ice seal in seal support as follows.

R (a) Thoroughly clean mating surfaces of anti-ice seal and seal support with 1,1,1-trichloroethane (MIL-T-81533) to remove all oil residue, then dry parts.

R (b) Coat mating surfaces of anti-ice seal and seal support with primer (MIL-S-22473, Grade T), then allow primer to air dry for 10 to 15 minutes.

R (c) Coat mating surfaces of anti-ice seal and seal support with compound (Loctite 40 or 640 (MIL-R-46082, Type 2)). Support seal support in 291144-1 holder and press seal into bore of seal support using 291146-1 driver.

R (d) Heat cure compound (Loctite 40 or 640 (MIL-R-46082, Type 2)) at 93C (200F) for 15 to 20 minutes.

R (2) Install new packings on buffered air tube. Attach buffered air tube to seal support with retainer and bolt. Tighten bolt (9) to torque of 60 inch-pounds.

R (3) Install new packing(s) on oil jet or tube assembly. If applicable, install tube assembly in lubricating nozzle. Position oil jet or tube assembly so that attaching tab will be located on stud when seal support is attached to planetary gear. Attach oil jet or lu-

R bricating nozzle with tube assembly to seal support
R with bolt(s). Tighten bolt (14) or bolts (14A) to
R torque of 50 inch-pounds.

R CAUTION: USE OF IMPROPER WASHER OR SPACER CAN
R CAUSE AN AIR LEAK OR BREAK THE SEAL
R SUPPORT TUBE SECURRING TAB.

R SINCE THERE ARE MULTIPLE CONFIGURA-
R TIONS FOR THE RETENTION OF THE SEAL
R SUPPORT TUBE SECURING TAB, ENSURE
R REINSTALLATION OF REMOVED COMPONENTS,
R UNLESS A MODIFICATION HAS BEEN
R PERFORMED.

R PLANET CARRIERS PART NO. 3071624-6
R WITH STUD (ADAPTER) USE SPACER PART
R NO. 3072516-1.

R PLANET CARRIERS PART NO. 3071624-6
R WITH LOCKING TYPE STUD AND PLANET
R CARRIERS PART NO. 3071624-7 USE
R SPACER PART NO. 3072516-1 THROUGH
R 3071624-6 AS DETERMINED IN THE FOL-
R LOWING STEP.

R 1. B. (4) (Installations incorporating Planet Carrier Part No.
R 3071624-6 with locking type stud and Planet Carrier
R Part No. 3071624-7) Ensure proper seal support tube
R float.

R (a) Inspect stud on planet carrier used to secure seal
R support tube to ensure that locking keys for stud
R are flush or below stud. If not, drive in keys.

R (b) Measure depth from carrier surface to top of
R recessed shoulder of stud for tab of seal support
R and record as Dimension A.

R (c) Measure thickness of seal support tab and record
R as Dimension B.

R (d) Add Dimensions A and B and record total as Dimen-
R sion C. Select spacer with height that is 0.010
R to 0.025 inch greater than Dimension C to obtain
R 0.010 to 0.025 inch float for tab of seal support.

R (e) Install seal support on planet carrier, then
R loosely install the three securing bolts.

R (f) Ensure spacer previously selected slides freely on
R stud within the seal support tube securing tab
R slot. If not, replace seal support.

R 1. B. (4) (g) Ensure there is no contact (top or bottom) between welded tab of anti-ice seal support, anti-ice tube, and adjacent surfaces on planet gear assembly or nut. Minimum clearance shall be 0.003 inch on each side of tab. If interference exists, select a spacer as required to obtain 0.003 inch minimum clearance on each side of the tab, providing 0.010 to 0.025 inch tube float can be maintained. If not, replace seal support.

(h) Ensure clearance between buffered air tube and seal support. If there is no clearance and tube is chafing seal support, refer to 4, Approved Repairs for rework of seal support.

(i) Remove seal support and spacer.

CAUTION: ENSURE PROPER WASHER OR SPACER IS INSTALLED UNDER OR IN (AS APPLICABLE) SECURING TAB OF SEAL SUPPORT TUBE.

(5) Install new packings and retainer ring on seal support tube. Position end of seal support tube in air transfer tube of planetary gear with washer under securing tab or spacer in securing tab. Position buffered air tube retainer as illustrated. Attach buffered air tube and seal support to planet gear assembly with bolts and new locking washers. Tighten bolts (5, 6) to torque of 145 inch-pounds and bend up tabs on locking washers.

(6) (Installations incorporating Planet Carrier Part No. 3071624-3) Secure welded tab on tubing of seal support to plaent gear assembly with screw and washers. Tighten screw (2) to torque of 35 inch-pounds.

(7) (Installations incorporating Planet Carrier Part No. 3071624-6 with stud (adapter)) Secure welded tab on tubing of seal support with nut, washer, and spacer. Tighten nut (2A) to torque of 35 inch-pounds.

(8) (Installations incorporating Planet Carrier Part No. 3071624-6 with locking type stud or Planet Carrier Part No. 3071624-7) Secure welded tab on tubing of seal support with nut, washer, and spacer selected in step (4). Tighten nut (2A) to torque of 35 inch-pounds. Ensure float specified in step (4) is maintained.

(9) Attach oil jet or tube assembly to planetary gear with nut. Tighten nut (8) to torque of 40 inch-pounds.

R NOTE: Remove covering from oil scavenge port
R at the 6 o'clock position in the strut
R of the intermediate case assembly.

R 1. B. (10) Install fan support assembly in accordance with 72-70-
R 06, MAINTENANCE PRACTICES.

R (11) Install compressor inlet stator in accordance with 72-
R 20-02, MAINTENANCE PRACTICES.

R (12) Install fan rotor assembly in accordance with 72-70-03,
R MAINTENANCE PRACTICES.

R (13) Install fan spinner and spinner support installation in
R accordance with 72-70-01, MAINTENANCE PRACTICES.

R C. (Codes A, B Post SB72-3085) Remove Lubricating Nozzle and
R Nozzle Support (See Figure 202)

R (1) Remove fan spinner and spinner support installation in
R accordance with 72-70-01, MAINTENANCE PRACTICES.

R (2) Remove fan rotor assembly in accordance with 72-70-03,
R MAINTENANCE PRACTICES.

R (3) Remove compressor inlet stator in accordance with 72-
R 20-02, MAINTENANCE PRACTICES.

R (4) Remove fan support assembly in accordance with 72-70-
R 06, MAINTENANCE PRACTICES.

R NOTE: Whenever the fan support assembly is
R removed from the engine, cover the oil
R scavenge port at the 6 o'clock position
R in the strut of the intermediate case
R assembly. This is to ensure that tools
R or hardware are not accidentally dropped
R into the opening.

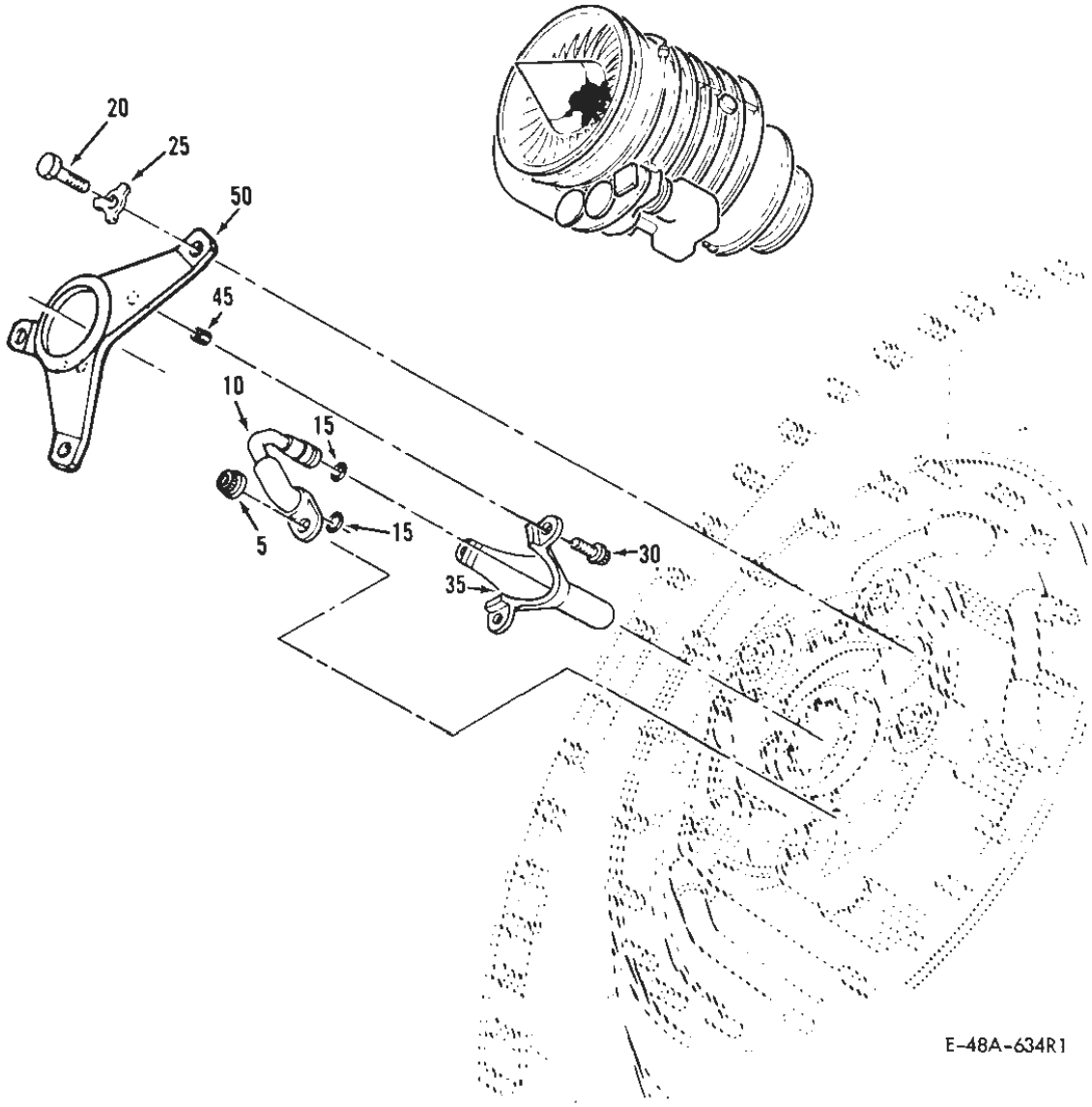
R (5) Remove nut securing tube assembly to engine.

R (6) Remove bolts and locking washers securing nozzle sup-
R port to engine. Remove assembled nozzle support, lu-
R bricating nozzle and tube assembly.

R (7) Remove bolts securing lubricating nozzle to nozzle sup-
R port and remove assembled lubricating nozzle and tube
R assembly.

R (8) Remove tube assembly from lubricating nozzle and remove
R packings from tube assembly.

R



R 5. NUT (IPC FIG. 83A)
R 10. TUBE ASSY
R 15. PACKING
R 20. BOLT
R 25. LOCKING WASHER
30. BOLT
35. LUBRICATING NOZZLE
*45. INSERT
50. NOZZLE SUPPORT

R *NOT REMOVED AT MAINTENANCE LEVEL

R (Codes A, B Post SB72-3085)
R Lubricating Nozzle and Nozzle Support
R Figure 202

R 1. D. (Codes A, B Post SB72-3085) Install Lubricating Nozzle and
R Nozzle Support (See Figure 202)

R NOTE: Refer to 70-00-00, STANDARD PRACTICES for
R general torque values. Add frictional dray
R (run-down) torque of self-locking devices to
R recommended values.

R (1) Install new packings on tube assembly. Install tube
R assembly in lubricating nozzle. Position tube assembly
R so that attaching tab will be located on stud when
R nozzle support is attached to planetary gear. Attach
R lubricating nozzle with tube assembly to nozzle support
R with bolts. Tighten bolts (30) to torque of 50 inch-
R pounds.

R (2) Install assembled nozzle support, lubricating nozzle
R and tube assembly on planetary gear while positioning
R tab on tube assembly over stud on planetary gear.
R Secure nozzle support with bolts and new locking
R washers.

R (3) Tighten bolts (20) to torque of 145 inch-pounds and
R bend up tabs on locking washers.

R (4) Attach tube assembly to planetary gear with nut.
R Tighten nut (5) to torque of 40 inch-pounds.

R NOTE: Remove covering from oil scavenge port
R at the 6 o'clock position in the strut
R of the intermediate case assembly.

R (5) Install fan support assembly in accordance with 72-70-
R 06, MAINTENANCE PRACTICES.

R (6) Install compressor inlet stator in accordance with 72-
R 20-02, MAINTENANCE PRACTICES.

R (7) Install fan rotor assembly in accordance with 72-70-03,
R MAINTENANCE PRACTICES.

R (8) Install fan spinner and spinner support installation in
R accordance with 72-70-01, MAINTENANCE PRACTICES.

R 2. Inspection/Check

R A. (Code C) (Codes A, B Pre SB72-3085) Inspect Anti-Ice Seal
R and Seal Support (See Figure 201)

R (1) Inspect anti-ice seal for the following.

R 2. A. (1) (a) Carbon ring sealing surface wear. Carbon sealing surface height shall be 0.020 inch or more as measured at four points 90 degrees apart.

(b) Carbon ring sealing surface damage.

1) Visually inspect for nicks and chipping. Nicks or chipping shall not extend, either individually or collectively, across more than ten percent of the radial width of the sealing surfaces, nor shall they occupy more than one-eighth of the circumference of either the ID or OD edge of the selaing surface.

2) Visually inspect for pits. Pits shall not be larger than 0.030 inch across their longest dimension, nor exceed 0.005 inch in depth. Spacing between adjacent edges of pits shall not be less than 0.100 inch.

3) Visually inspect for scratches. Scratches shall not exceed a depth of 0.001 inch or a width of 0.001 inch, nor a length across more than 30 percent of the radial width of the sealing surface. Spacing between adjacent scratches shall not be less than 0.050 inch.

(c) Seal housing retention. No axial shift is acceptable.

(d) Axial response of carbon element. Carbon shall readily return to free height when depressed.

(e) Coking of bellows. Coking shall not restrict axial response of anti-ice seal.

(f) Cocked condition of bellows. Bellows shall not be cocked. Cocking may be result of impoper alignment of seal support at last assembly.

(g) Integrity of bellows weld. No cracks are allowed. Cracking of bellows weld may be result of improper alignment of seal support at last assembly.

(h) Inspect for fretting of outside diameter of carbon carrier. Minor fretting is not cause for rejection but may be result of improper alignment of seal support at last assembly.

(2) Inspect tubes, and tube portions of oil jet, and seal support for cracks, dents causing a crease or which reduce diameter more than ten percent, chafing, corrosion, or internal obstruction.

R 2. A. (3) Inspect abradable seal diameter mating with knife-edge seals for damage to contact path, both axially and on circumference. Slight chips and nicks in the seal edges are acceptable. Cracks that do not extend beyond the first knife-edge seal groove are acceptable. Flaking and chipping that do not extend beyond all knife-edge seal grooves are acceptable. Eccentric grooved patterns in abradable material seal area are acceptable but groove depth shall not exceed 0.030 inch. Refer to 70-00-00, GENERAL - STANDARD PRACTICES for general requirements.

R (4) Inspect integral bracket on seal support tube at point where bracket is welded to tube for cracks.

R (5) Inspect buffered air tube for evidence of chafing with seal support. Replace buffered air tube if chafing is evident. Rework seal support to prevent recurrence of chafing in accordance with 4, Approved Repairs.

R (6) Replace anti-ice seal if inspection requirements of steps (1)(a) through (1)(h) are not met. Replace seal support if inspection requirements of steps (2), (3), or (4) are not met. Replace tube(s) and oil jet if inspection requirements of step (2) are not met.

R B. (Codes A, B Post SB72-3085) Inspect Lubricating Nozzle, Nozzle Support and Tube Assembly (See Figure 202)

R (1) Inspect lubricating nozzle and tube assembly for cracks, broken welds, chafing, corrosion, obstruction, and dents. Replace nozzle or tube assembly if cracks, chafing, obstruction, corrosion, or broken welds are evident. Dents which cause a crease or reduce diameter more than ten percent are not acceptable.

R (2) Inspect nozzle support for cracks, evidence of metal fatigue, security of inserts, and damaged or stripped insert threads. Replace parts that do not meet inspection requirements.

R 3. Cleaning/Painting

R A. Clean Parts

R Clean parts as specified in Table 203 in accordance with
R cleaning methods provided in 72-00-00, GENERAL -
R CLEANING/PAINTING.

R Table 203. Cleaning Methods
R

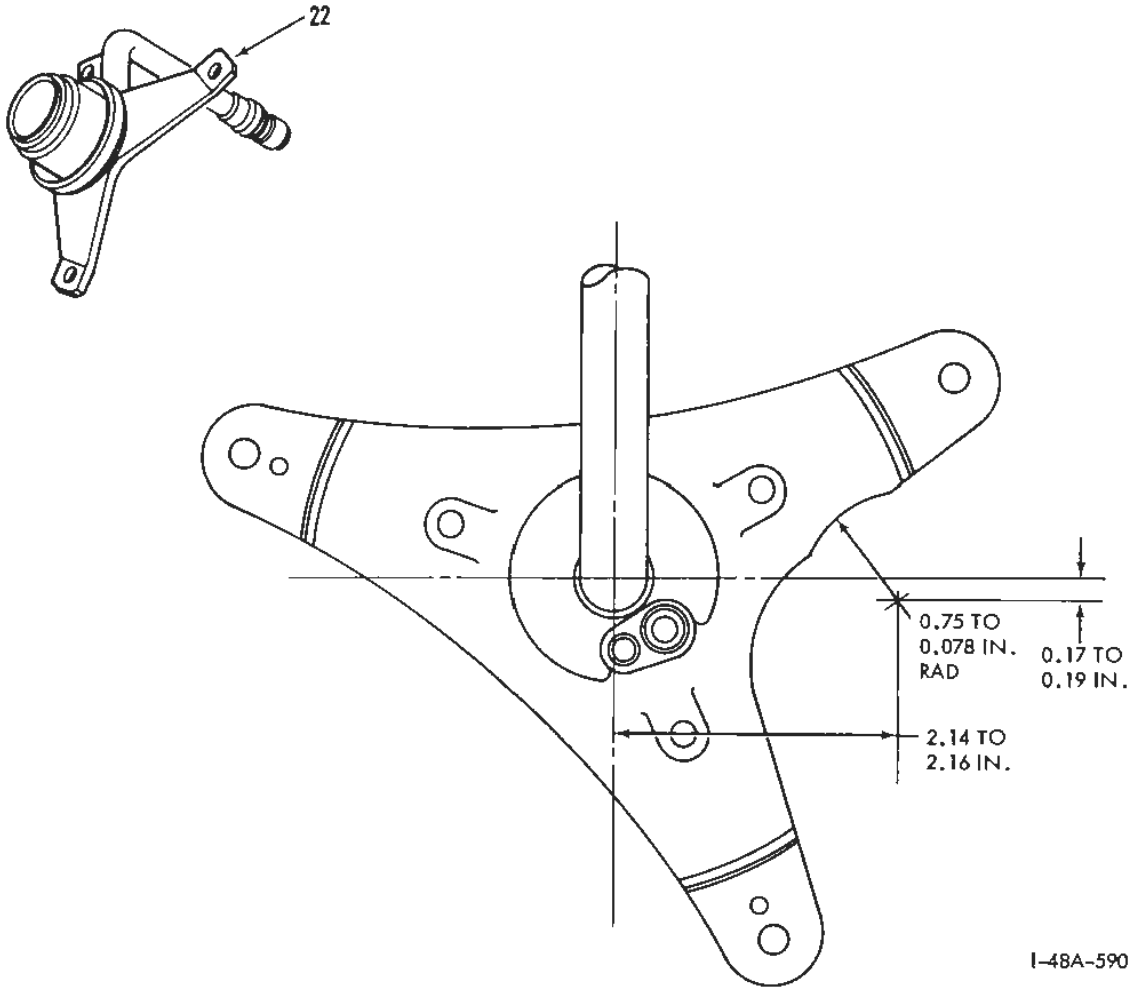
Figure No.	Item No.	Nomenclature	Cleaning Method 1	2	3	4	5	6	7	8	9	10	11	12
All standard metallic hardware			X	X										
201	12	Buffered Air Tube											X	
	15	Oil Jet											X	
	15A	Tube Assy											X	
	15C	Lubricating Nozzle											X	
	19	Face Bellows Seal (Anti-Ice)	X	X										
	21, 21B, 22	Seal Support	X	X										
202	10	Tube Assy											X	
	35	Lubricating Nozzle											X	
	50	Nozzle Support	X	X										

R 4. Approved Repairs

R A. Rework Seal Support (See Figure 203)

R Remove material from seal support by blending to dimensions
R specified in Figure 203.

R



R 22. SEAL SUPPORT (IPC FIG. 83)

R Seal Support Rework
R Figure 203

R PINION, PLANET GEAR, AND COUPLING SHAFT
R INSTALLATION - MAINTENANCE PRACTICES

R 1. Removal/Installation

R Table 201. Special Tools, Fixtures and Equipment
R

R Item No.	Nomenclature	Use	Source/ Part No.
R NOTE: Equivalent substitutes may be used for listed items.			
R 1.	Shaft Holding Wrench	Used for removing nut securing coupling shaft assembly.	289766-1
R 2.	Torque Wrench Adapter	Used for removing nut securing coupling shaft assembly	289776-1
R 3.	Coupling Mechanical Puller	Removes coupling shaft assembly.	291840-1
R 4.	LP Spool Holder	Secures LP spool components when removing nut securing coupling shaft assembly.	291839-1
R 5.	Baffle Guide Set	Aligns baffles for planet gearshaft assembly.	291899-1
R 6.	Planet Gear Assembly Holder	Supports planet carrier during planet gear assembly disassembly or assembly.	293665-1

R Table 202. Materials and Compounds
R

R Material or Compound	Manufacturer
R NOTE: Equivalent substitutes may be used for listed items.	
R Compound (Loctite 40 or 640) R (MIL-S-46082, Type II)	Loctite Corp, 705 N Mountain Rd, Newington, CT 06111

R Table 202. Materials and Compounds (Cont)

Material or Compound	Manufacturer
Grease (Acryloid HF-825 or HF-827)	Rohm and Haas Co, Independence Mall W, Philadelphia, PA 19105
Lubricating compound (Liqui-Moly, Grade NV, thread compound)	Lockrey Co, Lubricants Div, Cedar Shores, Southampton, NY 11968
*Primer (MIL-S-22473, Grade N)	Commercially available
1,1,1-Trichloroethane (MIL-T-81533)	Dow Corning Corp, S Saginaw Rd, Midland, MI 48640

*No substitutes for listed primer is allowed.

1. A. Remove Pinion and Planet Gear Assemblies (See Figures 201 and 202)

(1) Remove fan spinner and spinner support installation in accordance with 72-70-01, MAINTENANCE PRACTICES.

(2) Remove fan rotor assembly in accordance with 72-70-03, MAINTENANCE PRACTICES.

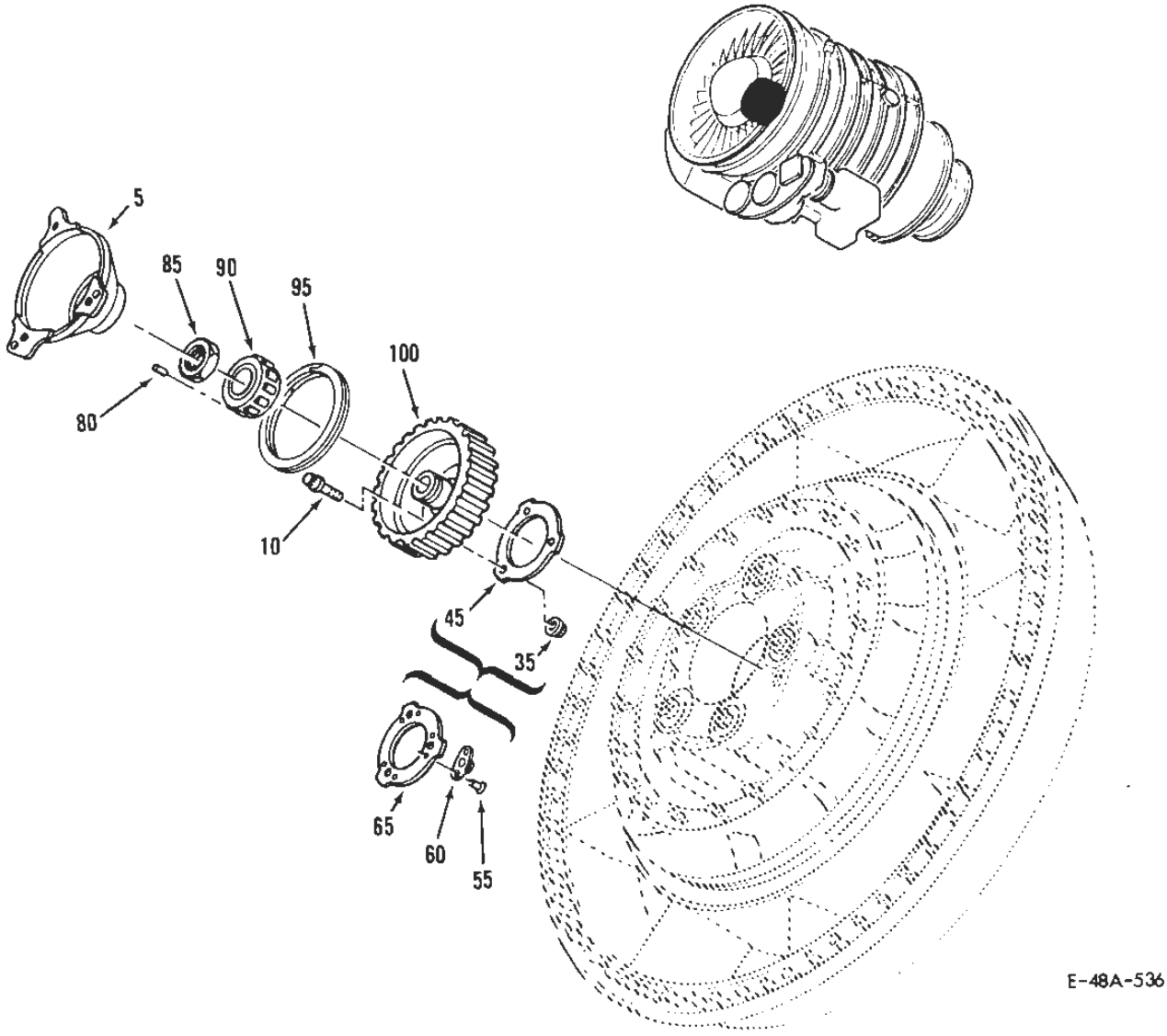
(3) Remove compressor inlet stator in accordance with 72-20-02, MAINTENANCE PRACTICES.

(4) Remove fan support assembly in accordance with 72-70-06, MAINTENANCE PRACTICES.

NOTE: Whenever the fan support assembly is removed from the engine, cover the oil scavenge port at the 6 o'clock position in the strut of the intermediate case assembly. This is to ensure that tools or hardware are not accidentally dropped into the opening.

(5) (Code C) (Codes A, B Pre SB72-3085) Remove anti-ice seal and seal support in accordance with 72-72-01, MAINTENANCE PRACTICES.

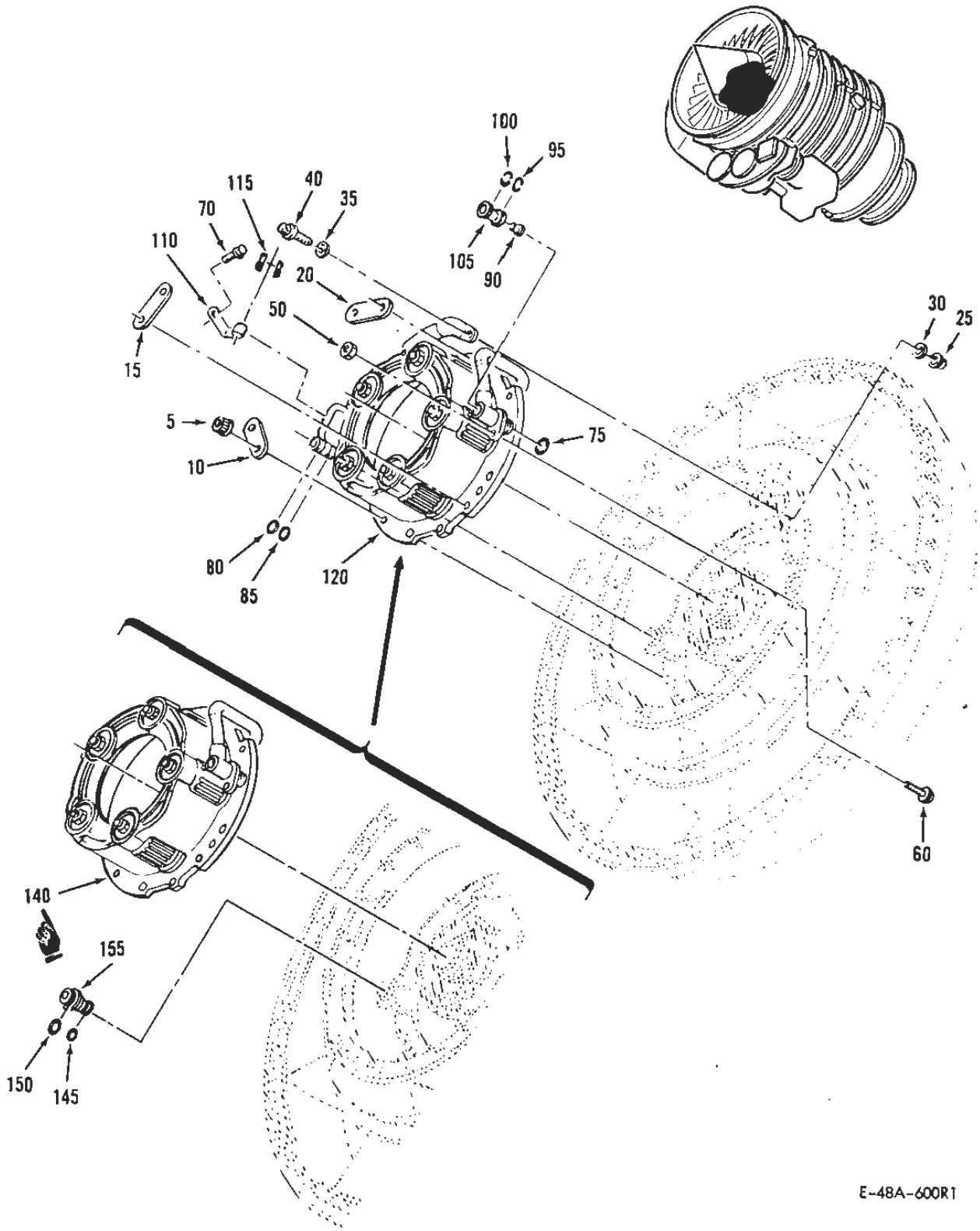
(6) (Codes A, B Post SB72-3085) Remove lubricating nozzle and nozzle support in accordance with 72-72-01, MAINTENANCE PRACTICES.



R	5.	BEARING CARRIER (AND OUTER RACE) (COMPONENT OF PLANET GEAR ASSY) (IPC FIG. 84)	**	60.	NUTPLATE
R	10.	BOLT		65.	RETAINER PLATE
R	*35.	NUT	**	80.	PIN
R	45.	RETAINER PLATE	**	85.	NUT
R	**55.	RIVET	**	90.	BEARING
R			*	95.	RETAINING RING (POST SB72-3064)
				100.	PINION GEARSHAFT

R *NOT REMOVED AT MAINTENANCE LEVEL
R **REMOVE ONLY FOR REPAIR

R Pinion Gear Assembly
R Figure 201



R Planet Gear Assembly
R Figure 202

R 1. A. (7) Remove bearing carrier (and outer race) of planet gear assembly to provide access to pinion gear assembly. If required, thread three 10-32 screws into empty threaded holes in bearing carrier to force carrier forward by jackscrew action. (See figure 201.)

R (8) Remove three bolts securing pinion gear assembly; remove pinion gear assembly.

R (9) Rotate retainer plate so tabs are aligned with slots in coupling shaft assembly, then remove retainer plate.

R (10) (Code C) (Codes A, B Pre SB72-3085) Remove nuts, dowel straps, bolts, clamp, washers (if installed), and grommet securing planet gear assembly (figure 202), then remove planet gear assembly. If required, thread three 10-32 screws into empty threaded holes in outer flange of planet gear assembly to force gear assembly forward by jackscrew action.

R (11) (Codes A, B Post SB72-3085) Remove nuts, dowel straps, and bolts securing planet gear assembly (figure 202), then remove planet gear assembly. If required, thread three 10-32 screws into empty threaded holes in outer flange of planet gear assembly to force gear assembly forward by jackscrew action.

R (12) Check four dowel pins of intermediate case assembly used for locating aft flange of planet gear assembly. If any dowel pins are missing or broken, refer to 4, Approved Repairs for dowel pin replacement.

R KEY TO FIGURE 202

R 5.	NUT (IPC FIG. 86)	90.	OIL JET STRAINER
R 10.	DOWEL STRAP	95.	PACKING
R 15.	DOWEL STRAP	100.	PACKING
R 20.	DOWEL STRAP	105.	OIL TRANSFER CONNECTOR
R 25.	NUT	*110.	CLAMP
R 30.	WASHER (PART DELETED)	*115.	GROMMET (SPLIT)
R 35.	WASHER (PART DELETED)	*120.	PLANET GEAR ASSY
R 40.	BOLT	**140.	PLANET GEAR ASSY
R 50.	NUT	**145.	PACKING
R 60.	BOLT	**150.	PACKING
R 70.	BOLT	**155.	BUFFER AIR TRANSFER CONNECTOR
R 75.	PACKING		
R 80.	PACKING		
R 85.	PACKING		

R *(CODE C) (CODES A, B PRE SB72-3085)
R **(CODES A, B POST SB72-3085)

R 1. A. (13) Remove packings from planet gear assembly.

R (14) Remove oil jet strainer, connector, and packings.

R (15) (Codes A, B Post SB72-3085) Remove buffer air transfer
R connector, then remove packings.

R B. Disassemble Planet Gear Assembly (See Figure 203)

R NOTE: When available, 293665-1 holder may be used
R to secure planet gear assembly for aid in
R disassembling components.

R (1) Remove planet gear assembly from engine in accordance
R with paragraph 1.A.

R (2) If installed, remove nut securing seal plug, then
R remove seal plug and packing from manifold assembly.

R (3) Remove nuts securing oil transfer tube to manifold as-
R sembly, then remove oil transfer tube and packing.
R Remove oil jet strainer.

R (4) (Code C) (Codes A, B Pre SB72-3085) Remove nut secur-
R ing buffer air transfer tube to planet carrier, then
R remove tube.

R (5) (Codes A, B Post SB72-3085) Remove nut (40) and washer
R (45).

R (6) Remove nuts securing manifold assembly, then remove
R manifold assembly from planet carrier.

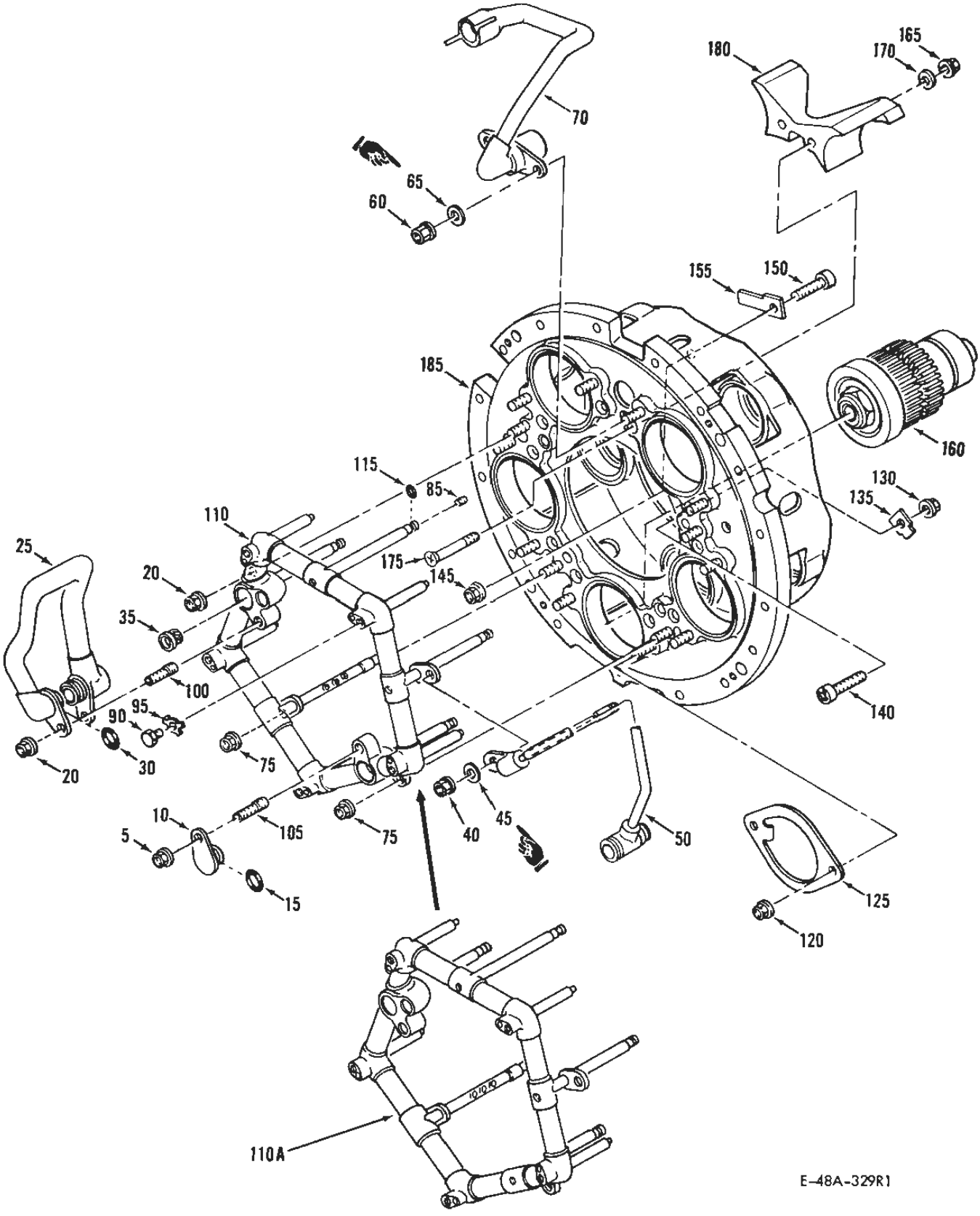
R (7) Remove packings from manifold assembly.

R (8) (Code C) (Codes A, B Pre SB72-3085) Remove nuts secur-
R ing air transfer tube, then remove tube.

R (9) (Codes A, B Post SB72-3085) Remove nuts (60) and wash-
R ers (65).

R (10) Remove nuts, washers, and screws securing forward and
R aft bearing retainers, then remove bearing retainers.

R (11) Remove gearshaft assemblies from planet carrier. Five
R gearshaft assemblies are matched (within 0.001 inch) by
R pin measurement value acid etched on shoulder of each
R gearshaft. If subsequent maintenance procedures
R require replacement of one or more gearshaft assem-
R blies, supply pin measurement values on remaining ser-
R viceable gearshaft assemblies when ordering replacement
R parts to ensure replacement and remaining serviceable
R gearshaft assemblies will be matched.



Planet Gear Assembly
Figure 203

R 1. B. (12) Remove nuts, washers, and screws securing oil baffles, then remove oil baffles.

R C. Remove Coupling Shaft Assembly (See Figure 204)

R (1) Remove pinion and planet gear assemblies in accordance with paragraph 1.A.

R CAUTION: TO PREVENT INADVERTENT LOOSENING OF THE NUT SECURING THE COMPRESSOR-END OF THE TIE ROD WHEN THE TURBINE-END OF THE LOW PRESSURE TIE ROD IS NOT STRETCHED, 291839-1 HOLDER MUST BE USED WHEN REMOVING THE NUT (10, FIGURE 204) SECURING THE COUPLING SHAFT ASSEMBLY.

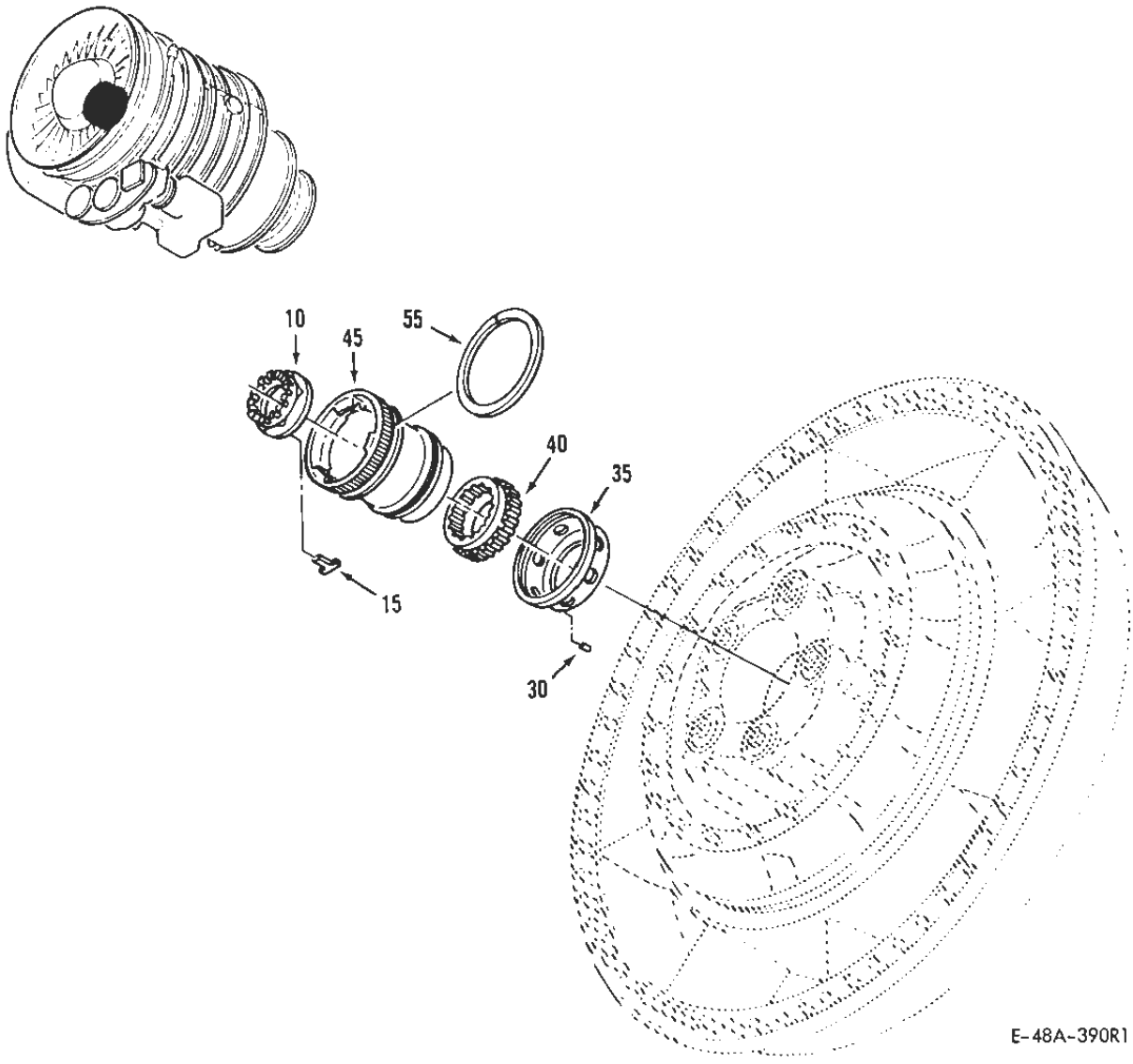
R (2) Bend down tab on locking key and remove nut using 289766-1 wrench to hold low pressure tie rod and 289776-1 adapter to rotate nut. Remove locking key. If turbine-end of low pressure tie rod is unstretched (nut of 72-50-04, figure 201 loosened or removed), prevent rotation of low pressure spool components by performing either of the two following steps.

R KEY TO FIGURE 203

R 5.	NUT (IPC FIG. 87)	* 90.	BOLT
R 10.	SEAL PLUG	* 95.	WASHER
R 15.	PACKING	* 100.	STUD
R 20.	NUT	105.	STUD
R 25.	OIL TRANSFER TUBE	110.	OIL MANIFOLD ASSY
R 30.	PACKING	110A.	OIL MANIFOLD ASSY
R 35.	OIL JET STRAINER	115.	PACKING
R 40.	NUT	120.	NUT
R 45.	WASHER (CODES A, B POST SB72-8085)	125.	AFT BEARING RETAINER
R 50.	BUFFER AIR TRANSFER TUBE (CODE C) (CODES A, B PRE SB72-3085)	130.	NUT
		135.	FORWARD BEARING RETAINER
		140.	SCREW
R 60.	NUT	145.	NUT
R 65.	WASHER (CODES A, B POST SB72-3085)	150.	SCREW
		155.	FORWARD BEARING RETAINER
R 70.	AIR TRANSFER TUBE (CODE C) (CODES A, B PRE SB72-3085)	160.	PLANET GEARSHAFT ASSY
		165.	NUT
R 75.	NUT	170.	WASHER
R *85.	SETSCREW	175.	SCREW
		180.	OIL BAFFLE
		185.	PLANET CARRIER

R *NOT REMOVED AT MAINTENANCE LEVEL

R



R 10. NUT (IPC FIG. 85)
R 15. LOCKING KEY
R *30. PIN
R *35. NUT
*40. COUPLING
*45. COUPLING
55. SEAL RING (PART DELETED)

R *NOT REMOVED AT MAINTENANCE LEVEL

R Coupling Shaft Assembly
R Figure 204

R 1. C. (2) (a) Secure low pressure spool components by installing
R 291839-1 holder over external splines of coupling
R shaft assembly and bolting holder in place.

R (b) Install removed turbine components to stretch tie
R rod at turbine-end.

R (3) Remove coupling shaft assembly using 291840-1 puller.
R (See figure 204.)

R (4) If installed, remove seal rings from coupling shaft as-
R sembly and discard seal rings.

R D. Install Coupling Shaft Assembly (See Figure 204)

R NOTE: Refer to 70-00-00, STANDARD PRACTICES for
R general torque values. Add frictional drag
R (run-down) torque of self-locking devices to
R recommended values.

R (1) Check for proper orientation of coupling (40) within
R coupling (45) of coupling shaft assembly (alignment
R mark on aft face of spline diameter on coupling (40) in
R line with pin (30)). If required, push coupling (40)
R forward to disengage splines, then re-engage splines at
R proper orientation.

R (2) Install coupling shaft assembly.

R (3) Coat fan shaft threads and threads and face of nut (10)
R with lubricating compound (Liqui-Moly, Grade NV, thread
R compound). Install nut (10).

R NOTE: Tool required to tighten nut (10)
R provides an offset of three inches from
R nut centerline to torque wrench connec-
R tion point, providing a difference in
R actual and indicated torques. Calculate
R indicated torque necessary to obtain
R required actual torque as described in
R 70-00-00, STANDARD PRACTICES, paragraph
R 3.

R (4) Using 289776-1 adapter, tighten nut (10) to torque of
R 1200 inch-pounds while holding coupling with 291839-1
R holder. (289766-1 wrench can be used in lieu of
R 291839-1 holder.)

R (5) Note alignment of shaft slots and castellations on nut
R (10) to establish suitable location for key. Note
R location of shaft slot selected for key.

R 1. D. (6) Loosen nut (10) using 289776-1 adapter and 291839-1 holder (or 289766-1 wrench) and remove. Install new locking key in noted location of shaft slot.

(7) Reinstall nut (10) and tighten to torque of 1200 inch-pounds using 289776-1 adapter and 291839-1 holder (or 289766-1 wrench). Continue to tighten nut (10), if necessary, to align shaft slots and castellation but do not exceed 1600 inch-pounds torque. Bend tab of locking key into slot in nut (10) to lock position.

(8) Install pinion and planet gear assemblies in accordance with paragraph 1.F.

E. Assemble Planet Gear Assembly (See Figure 203)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

When available, 293665-1 holder may be used to secure planet carrier for aid in assembling components.

(1) Install forward bearing retainers on planet carrier and secure with nuts and screws. Tighten nuts (130) to torque of 20 to 25 inch-pounds and screw (150) (installed on forward side of planet carrier) to torque of 40 to 50 inch-pounds.

(2) Install oil baffles using 291899-1 guide set to align parts. Secure with screws, washers, and nuts. Tighten nuts (165) to torque of 50 to 60 inch-pounds.

NOTE: Gearshaft assemblies are matched. Ensure inspection requirements are met prior to assembly.

When a replacement planet gearshaft is installed, SOAP samples are required to establish a new baseline for subsequent SOAP checks. Refer to 72-00-00, GENERAL - INSPECTION/CHECK.

(3) Install planet gearshaft assemblies. Align anti-rotation slot of bearing on planet gearshaft assemblies with forward bearing retainers.

R 1. E. (4) Install aft bearing retainers and secure with nuts. Tighten nuts (120) to torque of 40 inch-pounds.

(5) Install packings on manifold assembly and install manifold assembly. Secure with nuts. Tighten nuts (20, 75) to torque of 40 inch-pounds.

(6) (Code C) (Codes A, B Pre SB72-3085) Install buffer air transfer tube and secure with nut. Tighten nut (40) to torque of 40 inch-pounds.

(7) (Code C) (Codes A, B Pre SB72-3085) Install air transfer tube and secure with nuts. Tighten nuts (60) to torque of 40 inch-pounds.

(8) (Codes A, B Post SB72-3085) Install washers (65) and secure with nuts (60). Tighten nuts (60) to torque of 40 inch-pounds.

(9) (Codes A, B Post SB72-3085) Install washer (45) and secure with nut (40). Tighten nut (40) to torque of 40 inch-pounds.

(10) Install oil jet strainer in manifold assembly. Install packing on oil transfer tube. Install oil transfer tube with packing and secure with nut. Tighten nut (20) to torque of 40 inch-pounds.

(11) If applicable, install packing on seal plug. Install seal plug with packing and secure with nut. Tighten nut (5) to torque of 40 inch-pounds.

F. Install Pinion and Planet Gear Assemblies (See Figures 201 and 202)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictinal drag (run-down) torque of self-locking devices to recommended values.

(1) If previously disassembled, assemble planet gear assembly in accordance with paragraph 1.E.

(2) Install coupling shaft assembly in accordance with paragraph 1.D.

R NOTE: When a replacement planet gear assembly is installed, SOAP samples are required to establish a new baseline for subsequent SOAP checks. Refer to 72-00-00, GENERAL - INSPECTION/CHECK.

R 1. F. (3) Install new packings on oil transfer connector. Install oil jet strainer and connector into end of tube (40), figure 201, 79-20-10) on fan support housing (figure 201, 72-70-06).

R (4) (Codes A, B Post SB72-3085) Install new packings on buffer air transfer connector, then install connector.

R (5) Install new packings on planet gear assembly (figure 202).

R (6) With bearing carrier of planet gear assembly removed, position planet gear assembly on engine and secure with bolts, dowel straps, and nuts. Tighten nuts (5) to torque of 80 inch-pounds.

R (7) Attach oil pressure tube portion of planet gear assembly to mating adapter in intermediate case with bolt and nut. Tighten nut (50) to torque of 40 inch-pounds.

R (8) (Code C) (Codes A, B Pre SB72-3085) Attach anti-ice air tube portion of planet gear assembly to mating adapter in intermediate case with bolt, washers (if removed at disassembly), and nuts. Tighten bolts (40) to torque of 50 inch-pounds.

R CAUTION: ENSURE PROPER ALIGNMENT OF RETAINER PLATE IS MAINTAINED AS SPECIFIED IN THE FOLLOWING STEP AFTER INSTALLATION TO PREVENT DAMAGE DURING SUBSEQUENT PROCEDURES.

R NOTE: When a replacement pinion gearshaft is installed, SOAP samples are required to establish a new baseline for subsequent SOAP checks. Refer to 72-00-00, GENERAL - INSPECTION/CHECK.

R (9) Thoroughly clean bolts to be used to secure pinion gear assembly (figure 201) and nutplates (or nuts) on retainer plate with 1,1,1-Trichloroethane (MIL-T-81533).

R CAUTION: DO NOT USE SUBSTITUTE FOR SPECIFIED
R PRIMER IN THE FOLLOWING STEP.

R 1. F. (10) Apply primer (MIL-S-22473, Grade N) to threads of bolts
R (10) and nutplate (or nuts) on retainer plate. Allow
R primer to air-dry for five minutes.

R (11) Apply compound (Loctite 40 or 640 (MIL-R-46082, Type
R 2)) to threads of bolts (10) and nutplates (or nuts) on
R retainer plate as follows.

R (a) Dip threads of bolts (10) into compound allowing
R excess compound to drain from bolt (10) prior to
R installation.

R (b) Apply compound to threads of nutplates (or nuts)
R on retainer plate using a swab type applicator.

R (12) Position retainer plate in coupling shaft assembly with
R tabs of retainer plate centered behind tabs on coupling
R shaft assembly.

R CAUTION: PART NUMBER OF BOLTS USED TO ATTACH PINION
R GEAR ASSEMBLY IN THE FOLLOWING STEP DETER-
R MINES TORQUE TO BE APPLIED. BOLTS ARE IDEN-
R TIFIED ON END OF BOLT HEADS. INCORRECT
R TORQUE MAY RESULT IN BOLT BACKING OUT OF
R FASTENER OR DAMAGED THREADS. ENSURE PROPER
R TORQUE IS USED AT ASSEMBLY IN ACCORDANCE WITH
R THE FOLLOWING STEP.

R (13) Install pinion gear assembly and three bolts. Grease
R (Acryloid HF-825 or HF-827) may be used to hold bear-
R ings of pinion gear assembly in place to aid
R installation. Ensure nutplates (or nuts) on retainer
R plate provide minimum run-down torque of six inch-
R pounds. Ensure retainer plate tabs remain centered af-
R ter bolt installation and tightening. Install Bolts,
R Part No. 145-131-9010 (identified with H28 on bolt
R head) and tighten three bolts (10) to torque of 60
R inch-pounds. If Bolts, Part No. MS21279-06, MS21279-
R 07, or MS21279-08 (identified with MS number on bolt
R head) are used, tighten three bolts (10) to torque of
R 40 inch-pounds.

R (14) Install bearing carrier of planet gear assembly.

R (15) Move each planet gear fore and aft to ensure it is not
R binding on the pinion gear assembly.

R (16) (Code C) (Codes A, B Pre SB72-3085) Install anti-ice
R seal and support, in accordance with 72-72-01, MAINTEN-
R ANCE PRACTICES.

R 1. F. (17) (Codes A, B Post SB72-3085) Install lubricating nozzle and nozzle support in accordance with 72-72-01, MAINTENANCE PRACTICES.

NOTE: Remove covering from oil scavenge port at the 6 o'clock position in the strut of the intermediate case assembly.

(18) Install fan support assembly in accordance with 72-70-06, MAINTENANCE PRACTICES.

(19) Install compressor inlet stator in accordance with 72-20-02, MAINTENANCE PRACTICES.

(20) Install fan rotor assembly in accordance with 72-70-03, MAINTENANCE PRACTICES.

(21) Install fan spinner and spinner support installation in accordance with 72-70-01, MAINTENANCE PRACTICES.

R 2. Inspection/Check

A. Inspect Pinion Gear Assembly (See Figure 201)

(1) Inspect gear retainer plate for wear on retainer tabs. Wear shall not exceed 0.005 inch. Minor fretting or corrosion is acceptable. Nuts or nutplates on retainer plate shall be secure. Run-down torque of each nut or nutplate shall be six inch-pounds minimum when checked with bolt (10). If nutplates are not secure, are damaged, or do not have sufficient run-down torque, install new rivets and nutplates as required in accordance with 4, Approved Repairs.

(2) Inspect gear teeth on pinion gearshaft with assembled parts for wear, scoring, pitting, and other damage. Defects that exceed the following limits are cause for rejection.

(a) Depth of any scoring or wear shall not exceed 0.002 inch. Any areas of scoring (evident as high polish or wear) shall not exceed an area greater than 0.050 by 0.150 inch.

R NOTE: Micropitting specified in the following step is defined as miniature pits, generally of a size too small to measure individually, which may appear as frosting (a lusterless finish or a dull or matted appearance).

R 2. A. (2) (b) Micropitting on any tooth shall not exceed 85 percent of tooth contact surface.

R (c) Dimension of any single pit (in any direction) shall not exceed 0.010 inch. Number of pits (with the exception of micropitting) within any circle of 0.250 inch diameter shall not exceed three.

R (3) Inspect splines of pinion gearshaft with assembled parts for wear. Wear step near tooth root shall not exceed 0.002 inch.

R (4) (Post SB72-3064) Inspect pinion gearshaft retaining ring installed in forward internal groove of gearshaft, check for fretting adjacent to each end of retaining ring. If fretting exists, rotate retaining ring 90 degrees. New orientation for ends of retaining ring shall not be in line with any previously fretted surfaces in groove on either forward or aft sides of retaining ring.

R (5) Inspect bearing installed on pinion gearshaft in accordance with 70-00-00, 7, Bearing Handling and Inspection. If bearing damage is evident or suspected, replace bearing in accordance with 4, Approved Repairs.

R (6) Perform magnetic particle inspection of pinion gearshaft in accordance with MIL-I-6868. Pay particular attention to area outboard of bolt holes and just inside gear rim and to roots of gear teeth. Cracks are not acceptable.

R (7) Replace parts not meeting inspection requirements of steps (1) through (6).

R B. Inspect Planet Gear Assembly Oil Jet Strainer (See Figure 202)

R (1) Inspect oil jet strainer (pressed into oil transfer connector) for clogging, torn wire mesh, or other damage.

R (2) If required, drive out damaged strainer and install new strainer using arbor press.

R 2. C. Inspect Planet Gear Assembly Gearshaft Assemblies (See Figure 203)

(1) Inspect planet gearshaft assemblies, removed from planet carrier, for matched condition by checking pin measurement values stamped on shoulder of each gearshaft. Values shall be matched within 0.001 inch.

(2) Inspect planet gearshaft assembly bearing as follows.

CAUTION: DO NOT REMOVE MORE THAN ONE OUTER RACE FROM PLANET GEARSHAFT ASSEMBLY BEARINGS AT A GIVEN TIME AS THE RACES ARE NOT INTERCHANGEABLE. IF MIXING DOES OCCUR, THE SERIAL NUMBER AT EACH OUTER RACE SHALL BE MATCHED WITH THE RESPECTIVE INNER RACE SERIAL NUMBER.

(a) With outer race at each bearing removed, inspect bearings in accordance with 70-00-00, 7, Bearing Handling and Inspection. Cage pocket wear illustrated in 70-00-00, Figure 14 is not acceptable for planet gearshaft assembly bearings.

(b) Check bearings for freedom of rotation as follows.

1) Hold gearshaft in vertical position by outer race of lower bearing to check lower bearing. Rotate gearshaft with free hand. Bearing rollers, bearing cage, and gearshaft shall rotate freely. Correct any binding by replacing nut for bearing failing check in accordance with 4, Approved Repairs.

2) With gearshaft maintained in position established in step 1), hold outer race and cage of lower bearing stationary with fingers. Rotate gearshaft with free hand. Gearshaft and bearing rollers shall rotate freely. Correct any binding by replacing nut for bearing failing check in accordance with Approved Repairs.

3) Repeat steps 1) and 2) for other bearing on gearshaft.

4) Repeat steps 1) through 3) for other four gearshaft assemblies.

(3) Inspect gear teeth on planet gearshafts for wear, scoring, pitting, and other damage. Defects that exceed the following limits are cause for rejection.

R 2. C. (3) (a) Depth of any scoring or wear shall not exceed
R 0.002 inch. Any areas of scoring (evident as high
R polish or wear) shall not exceed an area greater
R than 0.050 by 0.150 inch.

R NOTE: Micropitting specified in the fol-
R lowing step is defined as miniature
R pits, generally of a size too small
R to measure individually, which may
R appear as frosting (a lusterless
R finish or a dull or matted
R appearance).

R (b) Micropitting on any tooth shall not exceed 85 per-
R cent of tooth contact surface.

R (c) Dimension of any single pit (in any direction)
R shall not exceed 0.010 inch. Number of pits (with
R the exception of micropitting) within any circle
R of 0.250 inch diameter shall not exceed three.

R 2. C. (4) Inspect forward and aft pin (figure 205) for security.
R If not secure refer to 4, Approved Repairs.

R NOTE: When ordering planet gearshaft assem-
R blies for replacement of defective
R parts, supply pin measurement values
R stamped on shoulder of remaining ser-
R viceable gearshaft assemblies. Data is
R required to ensure replacement gearshaft
R assemblies will be matched with remain-
R ing serviceable gearshaft assemblies.

R (5) Replace parts not meeting inspection requirements of
R steps (1) through (4).

R D. Inspect Planet Gear Assembly Oil Jet Strainer (See Figure
R 203)

R Inspect oil jet strainer for clogging, torn wire mesh, or
R other damage. Replace part if damage is evident.

R E. Inspect Planet Gear Assembly Carrier (See Figure 203)

R (1) Inspect intermediate case mounting feet on planet car-
R rier for fretting. Minor fretting is acceptable
R providing no cracks have spread from fretting.

R (2) Replace part that does not meet inspection
R requirements.

R F. Inspect Coupling Shaft Assembly (See Figure 204)

R (1) Inspect coupling shaft assembly external splines for
R wear. Wear patterns shall not run off ends of teeth.
R Wear step near tooth root shall not exceed 0.002 inch.
R Pitting shall not exceed 0.010 inch depth.

R (2) Replace part that does not meet inspection
R requirements.

R 3. Cleaning/Painting

R A. Clean Parts

R (1) Clean parts as specified in Table 203 in accordance
R with cleaning methods provided in 72-00-00, GENERAL -
R CLEANING/PAINTING.

Table 203. Cleaning Methods

Figure No.	Item No.	Nomenclature	Cleaning Methods 1	2	3	4	5	6	7	8	9	10	11	12
All standard metallic hardware			X	X										
201	5	Bearing Carrier	X	X										
	45	Retainer Plate	X	X										
	55,60, 65	Retainer Plate Assy	X	X										
	80 thru 100	Pinion Gear Assy		X										
202	10	Dowel Strap	X	X										
	15	Dowel Strap	X	X										
	20	Dowel Strap	X	X										
	90	Oil Jet Strainer	Refer to Specific Cleaning Instructions.											
	105	Oil Transfer Connector												X
	120, 140	Planet Gear Assy	X	X										
	155	Buffer Air Transfer Connector	X	X										
203	10	Seal Plug	X	X										
	25	Oil Transfer Tube												X
	35	Oil Jet Strainer	Refer to Specific Cleaning Instructions.											
	50	Buffer Air Transfer Tube												X
	70	Air Transfer Tube												X
	85 thru 110	Oil Manifold Assy												X
	160	Planet Gearshaft Assy	X	X										
	180	Oil Baffle	X	X										
	185	Planet Carrier	X	X										
204	10	Nut	X	X										
	30 thru 45	Coupling Shaft	X	X										
	55	Seal Ring	X	X										

R 4. Approved Repairs

R Table 204. Special Tools, Fixtures and Equipment
R

R Item No.	Nomenclature	Use	Source/ Part No.
R NOTE: Equivalent substitutes may be used for listed items.			
R 1.	Automatic Center Punch	Stakes pin during assembly.	285748-1-1
R 2.	Fixed Depth Gage	Checks hole depth for pins.	285998-1-1
R * 3.	Planet Gear Assembly Drill Jig	Supports planet gearshaft for disassembly and assembly operations.	289796-1
R * 4.	Bearing Puller	Removes planet gearshaft bearing.	289797-1
R * 5.	Bearing Driver	Installs planet gearshaft bearing.	289803-1
R * 6.	Bearing Driver	Installs planet gearshaft bearing	289804-1
R 7.	Torquing and Drilling Fixture	Supports pinion gear assembly during disassembly and assembly.	289835-1
R 8.	Bearing Puller	Removes bearing inner race from pinion gearshaft.	289836-1
R * 9.	Bearing Puller	Removes planet gearshaft bearing.	289837-1
R *10.	Balancing Insert Set	Supports planet gearshaft for balancing operation.	289936-1
R 11.	Staking Punch Adapter	Stakes pin during assembly.	294681-1

R *For use only at a Garrett Approved Repair Center.
R

R 4. A. Replace Defective Bearings on Planet Gearshaft Assembly

R CAUTION: REPAIR PROCEDURES OF PARAGRAPH 4.A. SHALL BE PERFORMED ONLY BY A GARRETT APPROVED REPAIR CENTER. SERVICE CENTER REPAIR IS NOT AUTHORIZED.

R (1) If both large and small bearings are to be replaced, perform repair in accordance with step (2). If only one bearing requires replacement, perform repair in accordance with step (3). Before performing repair of step (3), check runout of outer race on bearing not to be replaced as follows to ensure bearing is serviceable.

R (a) Locate gearshaft on countersunk recesses of gearshaft ends. Ensure recesses (centers) are clean and free of burrs to provide valid indications.

R (b) Measure runout at center of bearing outer race by holding outer race stationary and rotating gearshaft. Runout shall not exceed 0.0005 inch total indicator reading. If runout requirement is exceeded, eplace both large and small bearings in accordance with step (2). If runout requirement is met, replace defective bearing only in accordance with step (3).

R Table 205. Materials and Compounds

R Material or Compound	Manufactuer
R NOTE: Equivalent substitutes may be used for listed items.	
R Lubricating compound (Liqui-Moly, Grade NV, thread compound)	Lockrey Co, Lubricants Div, Cedar Shores, Southampton, NY 11968
R Solvent, Trichloro-trifluoroethane (MS-180 Freon)	Miller-Stephensen Chemical Co, Inc, P.O. Box 628, Danbury, CT 06810
R 1,1,1-Trichloroethane (MIL-T-81533)	Dow Corning Corp, S Saginaw Rd, Midland, MI 48640

R 4. A. (2) Replace large and small bearings of planet gearshaft assembly as follows.

(a) Disassemble planet gearshaft assembly as follows. (See figure 205.)

CAUTION: BEARING COMPONENTS ARE NOT INTERCHANGEABLE. ENSURE COMPONENTS OF EACH BEARING ARE KEPT TOGETHER AS A SET. OUTER AND INNER BEARING RACES OF EACH SET ARE SERIALIZED WITH SAME NUMBER.

1) Install planet gearshaft assembly in holder portion of 289796-1 drill jig. Use protective covering (masking tape, etc.) over ends of gearshaft and nuts for bearings to protect assembly from drill chips and nay foreign matter. Install plate of drill jig marked REMOVAL over large bearing end of gearshaft assembly with gearshaft assembly oriented to center drill guide hole in REMOVAL plate over pin in nut for large bearing. (See figure 206.)

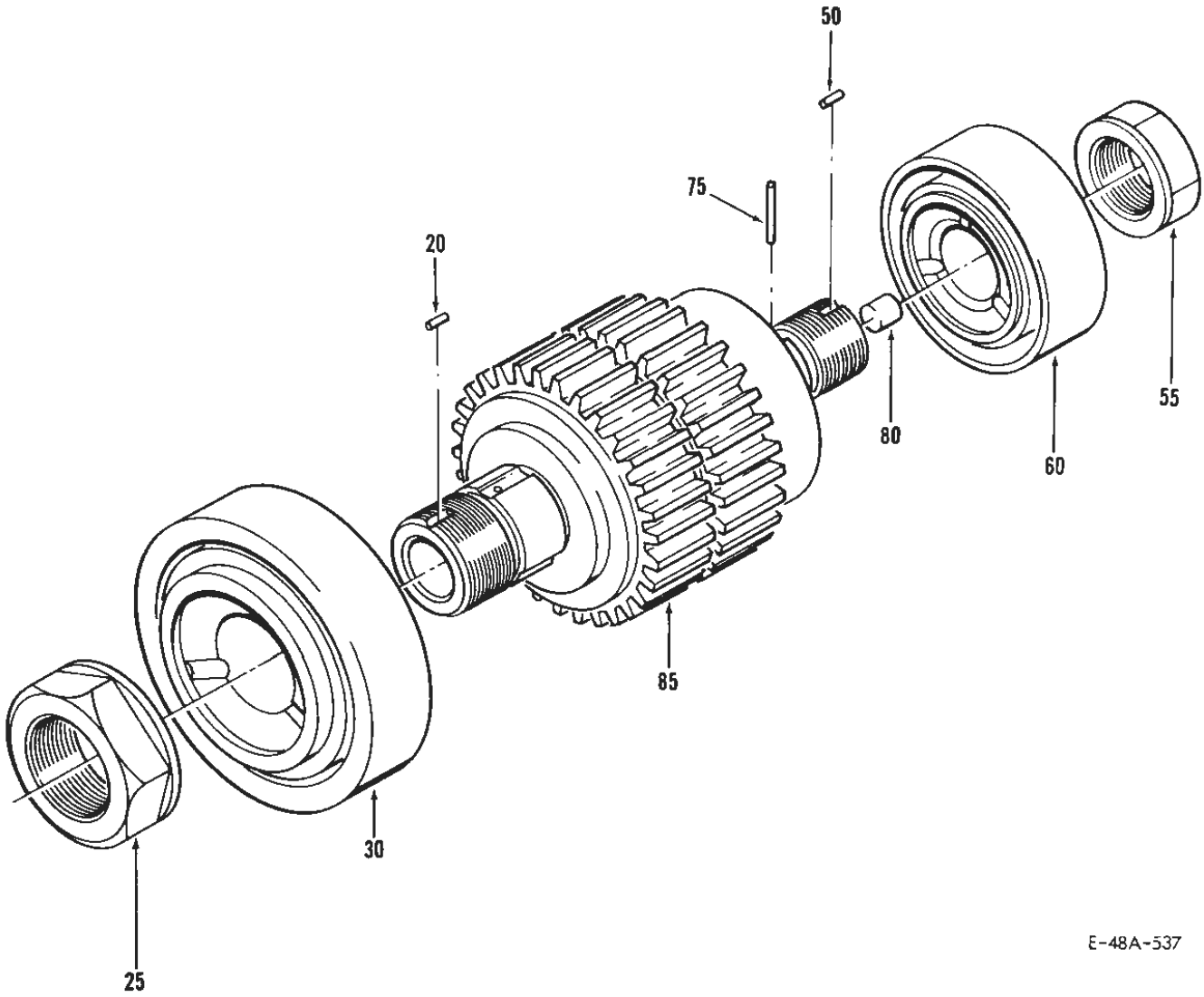
CAUTION: WHEN PERFORMING THE FOLLOWING STEPS, ENSURE COMPLETE REMOVAL OF PIN, ANY DRILL CHIPS, AND ANY DEBRIS FROM DRILLED HOLE. PRESENCE OF ANY MATERIAL LEFT IN DRILLED HOLE WILL DAMAGE THREADS AT NUT REMOVAL.

2) Drill out pin using 0.0625 inch diameter (1/16 inch) drill to a depth of 0.230 inch. Ensure complete removal of pin and any drill chips. Clean off drill chips and any foreign matter using vacuum, magnet, or tape, as required.

3) Remove REMOVAL plate of drill jig and protective covering from end of gearshaft for large bearing. Verify assembly is free of all drill chips and foreign matter using 10X magnification. Flush drilled hole with solvent, trichlorotrifluoroethane (MS-180 Freon) and use magnetized needle as required to completely clean drilled hole.

4) Invert gearshaft assembly in holder, with gearshaft assembly oriented to center drill guide hole of plate marked REMOVAL over pin in nut for small bearing.

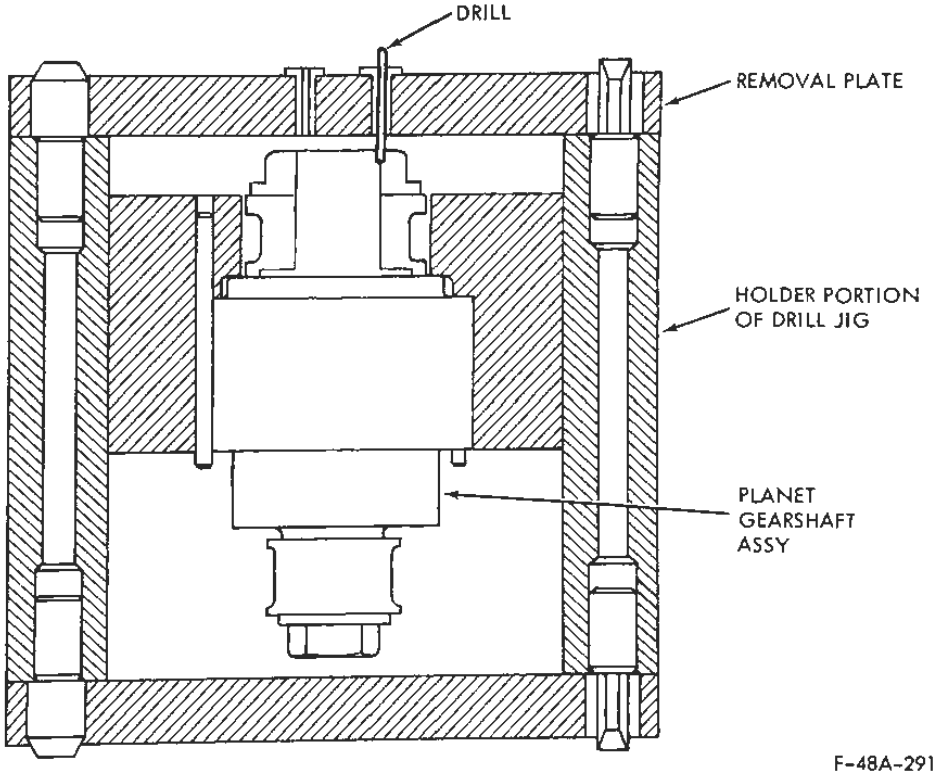
R



R 20. AFT PIN (IPC FIG. 88)
R 25. AFT NUT
R 30. LARGE BEARING
R 50. FORWARD PIN
R 55. FORWARD NUT
60. SMALL BEARING
75. SPRING PIN
80. RESTRICTOR
85. GEARSHAFT

R Planet Gearshaft Assembly
R Figure 205

R



R Use of Drill Jig PN 289796-1
R Figure 206

R CAUTION: WHEN PERFORMING THE FOLLOWING STEPS, ENSURE COMPLETE REMOVAL OF PIN, ANY DRILL CHIPS, AND ANY DEBRIS FROM DRILLED HOLE. PRESENCE OF ANY MATERIAL LEFT IN HOLE WILL DAMAGE THREADS AT NUT REMOVAL.

R 4. A. (2) (a) 5) Drill out pin using 0.0625 inch diameter (1/16 inch) drill to a depth of 0.230 inch. Ensure complete removal of pin and any drill chips. Clean off drill chips and any foreign matter using vacuum, magnet, or tape, as required.

R 6) Remove REMOVAL plate of drill jig and protective covering from end of gearshaft for small bearing. Verify assembly is free of all drill chips and foreign matter using 10X magnification. Flush drilled hole with solvent, trichlorotrifluoroethane (MS-180 Freon) and use magnetized needle as required to completely clean drilled hole.

R 7) Loosen and remove nut for small bearing.

R 8) Invert gearshaft assembly in holder and loosen and remove nut for large bearing.

R 9) Remove gearshaft from holder.

R CAUTION: WHEN REMOVING SMALL BEARING IN THE FOLLOWING STEP, ENSURE COUNTERBORED FACE OF 289797-1 PULLER FACES BODY OF GEARSHAFT. IF PULLER IS INSTALLED BACKWARDS, BEARING WILL BE DESTROYED.

R 10) Using 289837-1 puller, remove large bearing from gearshaft. Using 289797-1 puller, remove small bearing from gearshaft.

R NOTE: Do not remove spring pin or restrictor from gearshaft unless damage is indicated by inspection.

R 4. A. (2) (b) Inspect gearshaft for damage as follows. (See figure 207.)

R 1) Refinish Surfaces A and B by machining in accordance with good shop practices to obtain a surface finish of AA16 or better.

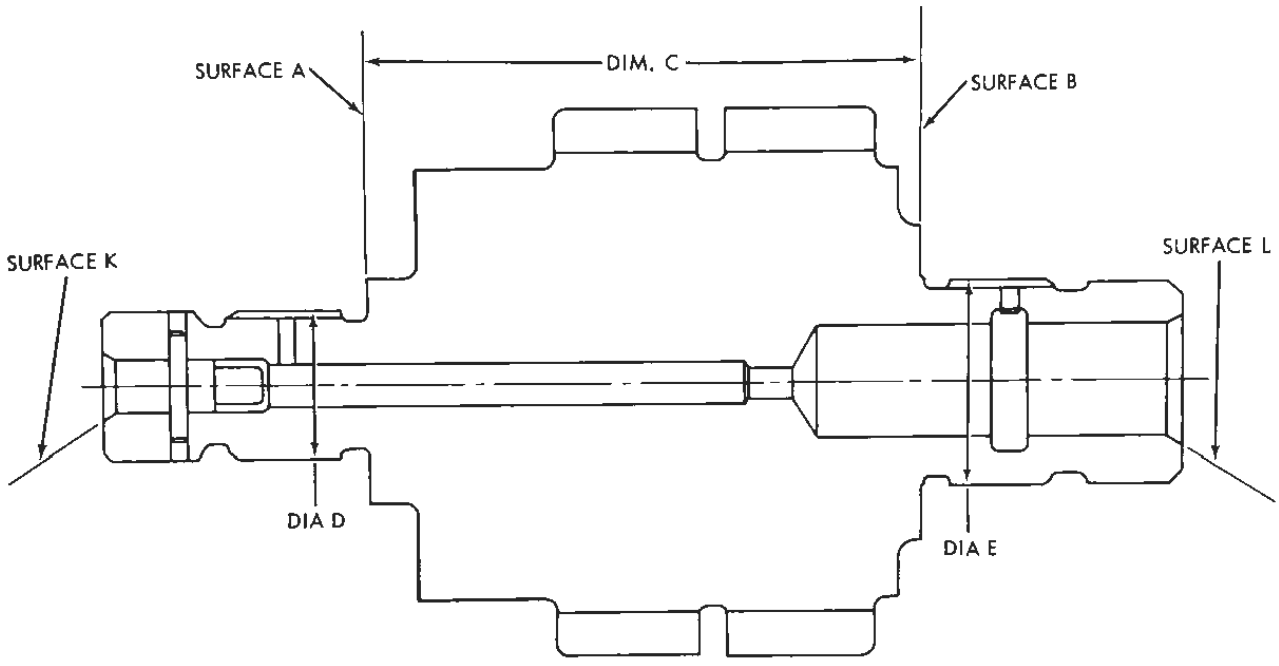
R 2) Dimension C shall be 2.086 inches minimum after machining, with a surface finish of AA16 or better.

R 3) Perform runout checks with reference to Surfaces K and L on Surfaces A and B, and Diameters D and E. Face runout on Surfaces A and B shall not exceed 0.0002 inch total indicator reading. Radial runout of Diameters D and E shall not exceed 0.0002 inch total indicator reading.

R (c) Balance gearshaft as follows. (See figure 208.)

R CAUTION: CRITICAL GEARSHAFT DIMENSION MAY BE ELECTROETCHED IN AREA TO BE MACHINED FOR BALANCING. (SEE FIGURE 207, DETAIL G.) PRIOR TO REMOVING MATERIAL IN SPECIFIED AREA, RECORD DIMENSION FROM GEARSHAFT. IF MATERIAL REMOVAL DESTROYS ELECTROETCHED DIMENSION, RE-ESTABLISH DIMENSION BY ELECTROETCHING WHEN BALANCING IS COMPLETED. ACID ETCH DIMENSION ON SAME SHOULDER OF GEARSHAFT WHERE DIMENSION PREVIOUSLY APPEARED, AT AN AREA WHERE NO MATERIAL HAS BEEN REMOVED FOR BALANCING.

R 1) Adapt gearshaft to standard balancing machine using 289936-1 balancing insert set with gearshaft supported on recessed locations between threads and bearing surfaces.



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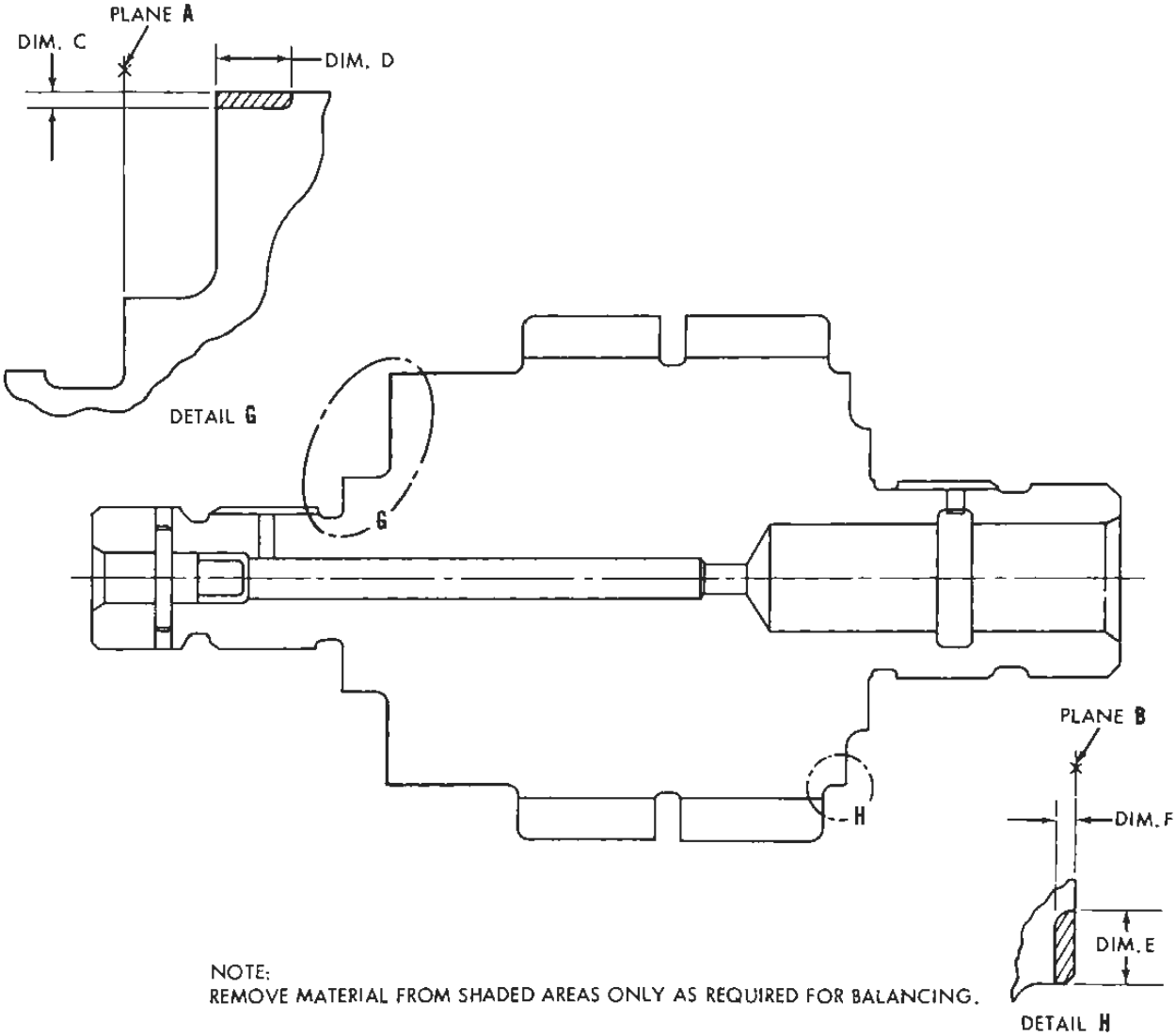
R Inspection of Planet Gearshaft
R Figure 207

R



NOTE:
REMOVE MATERIAL FROM SHADED AREAS ONLY AS REQUIRED FOR BALANCING.

C	D	E	F
0.03 IN. MAX	0.150 IN. MAX	0.14 IN. MAX	0.04 IN. MAX

I-48A-221R1

R Planet Gearshaft Balancing Requirements
R Figure 208

R 4. A. (2) (c) 2) Dynamically balance gearshaft to an accuracy
R of 0.0008 ounce-inch in Planes A and B, Figure
R 207. Material may be removed from areas
R designated. All places where material is
R removed for balancing shall fair smoothly and
R leave no corners or edges sharper than 0.06
R inch radius and have a surface finish of AA125
R or better.

R 3) Perform magnetic particle inspection (in ac-
R cordance with MIL-I-6868) of gearshaft after
R balancing.

R 4) Clean gearshaft by flushing with 1,1,1-
R trichloroethane (MIL-T-81533).

R (d) Inspect bearings to be installed on gearshaft as
R follows.

R 1) Inspect bearings in accordance with 70-00-00,
R 7, Bearing Handling and Inspection.

R 2) Visually inspect surfaces of bearings (which
R will mate with Surfaces A and B (figure 207)
R at installation on gearshaft) under a strong
R light. Replace bearing if any fretting is
R visible.

R (e) Assemble planet gearshaft assembly as follows.
R (See figure 205.)

R 1) Inspect gearshaft threads and nuts to be in-
R stalled on gearshaft for burrs. Remove any
R burrs using rotary wire brush, burr knife, or
R grinding wheel, as required. Nuts shall turn
R freely on gearshaft threads with no binding.
R Verify parts are free of burrs with 10X
R magnification.

R 2) Flush gearshaft and nuts with 1,1,1-
R trichloroethane (MIL-T-81533), then dry by
R blowing with compressed air.

R 3) Press small bearing on gearshaft using 289803-
R 1 driver. Press large bearing on gearshaft
R using 289804-1 driver. Install inner races of
R bearings with chamfer on inner diameter facing
R gear teeth on gearshaft and with grooves on
R inner races turned 55 to 65 degrees from
R grooves on gearshaft.

R 4. A. (2) (e) 4) Check hardness of forward and aft nuts prior to installing. Rockwell hardness shall be RHc 28 minimum. If either nut does not meet hardness requirements, discard nut failing check and repeat check for replacement nut.

5) Lubricate face and threads of forward and aft nuts with lubricating compound (Liqui-Moly, Grade NV, thread compound).

NOTE: When performing the following step, use same nuts for torque application as will be used on assembled gearshaft.

6) Install gearshaft in holder portion of 289796-1 drill jig and install forward and aft nuts. Tighten aft (large bearing) nut to 1150 inch-pounds torque, then loosen and retighten nut to 1150 inch-pounds torque two additional times. Tighten forward (small bearing) nut to 520 inch-pounds torque, then loosen and retighten nut to 520 inch-pounds torque two additional times.

6a) If either nut installed and gearshaft have been previously drilled for pinning, ensure half-hole in nut is a minimum of 0.150 inch from existing half-hole in gearshaft threads to be used.

7) Remove gearshaft form holder portion of 289796-1 drill jig. Apply clean engine oil (72-00-00, GENERAL - SERVICING, Table 301) to bearings.

8) Check bearing for freedom of rotation as follows.

a) Hold gearshaft in vertical position by outer race of lower bearing to check lower bearing. Rotate gearshaft with free hand. Bearing rollers, bearing cage, and gearshaft shall rotate freely. Correct any binding by replacing nut for bearing failing check, then repeating checks in accordance with steps 1) through 8).

b) With gearshaft maintained in position established in step a), hold outer race and cage of lower bearing stationary with fingers. Rotate gearshaft with free hand. Gearshaft and bearing rollers shall rotate

freely. Correct any binding by replacing nut for bearing failing check, then repeating checks in accordance with steps 1) through 8).

4. A. (2) (e) 8) c) Repeat steps a) and b) for other bearing on gearshaft.

9) Check runout of bearing outer races with gearshaft located on countersunk recesses of gearshaft ends. Ensure recesses (centers) are clean and free of burrs to provide valid indications. Measure runout at center of each bearing outer race. Measure by holding outer race stationary and rotating gearshaft. Runout shall not exceed 0.0005 inch total indicator reading at either outer race. Correct excessive runout by replacing nut for bearing with greatest runout, then repeating checks in accordance with steps 2) through 9).

10) Use protective covering (masking tape, etc.) over ends of gearshaft and nuts for bearings to protect assembly from drill chips and any foreign matter. Install drill plate of 289796-1 drill jig marked INSTALLATION over gearshaft with small bearing end located up, and with gearshaft oriented to locate 0.261 inch radius hole in drill plate over an existing half-hole in gearshaft threads (when gearshaft threads have been previously drilled). Ensure drill guide bushing of drill plate is against end of gearshaft assembly to prevent any wobble of drill during drilling operation.

11) Drill hole into threads of nut (and gearshaft, when gearshaft has not been previously drilled) using 0.0625 inch (1/16 inch) diameter drill. Drill hole to depth of 0.18 +0.01/-0.01 inch. Remove drill plate and check depth of drilled hole using 285998-1-1 gage. Clean off drill chips and any foreign matter using vacuum, magnet, or tape as required.

12) Remove protective covering from end of gearshaft. Turn gearshaft to orient drilled hole down and rinse drilled hole with solvent, trichlorotrifluoroethane (MS-180 Freon) to remove drill chips.

R 4. A. (2) (e) 13) Inspect drilled hole with 10X magnification for drill chips. Remove any chips using a magnetized needle.

13a) Check drilled hole to ensure hole is not oversized using a 0.0636 inch diameter inspection gage pin. Gage pin shall not fit into hole. If hole is oversized, repeat steps 10) through 13a) using different existing half-hole in gearshaft for drilling nut. If other existing half-holes in gearshaft are unusable, or if no other half-holes exist in gearshaft threads, drill new hole approximately 45 degrees from any other half-hole in gearshaft. Any new half-holes drilled in nut shall be at least 0.150 inch from any existing half-hole in nut. Maximum allowable combined number of half-holes in gearshaft threads and nut is seven.

14) Press pin to bottom of drilled hole and stake center of pin using 285748-1-1 punch.

15) Remove stylus from 285748-1 punch and install 294681-1 adapter in place of removed stylus.

16) Centerstake hole for pin using 285748-1 punch and 294681-1 adapter to displace nut and gearshaft material around perimeter of pin. Ensure nut and gearshaft material is displaced to secure pin.

17) Remove 294681-1 adapter from 285748-1-1 punch and reinstall stylus removed in step 15).

18) Invert gearshaft and holder and install INSTALLATION drill plate over gearshaft with gearshaft oriented to locate 0.380 inch radius hole in drill plate over an existing half-hole in gearshaft threads (when gearshaft threads have been previously drilled). Ensure drill guide bushing of drill plate is against end of gearshaft assembly to prevent any wobble of drill during drilling operation.

19) Drill hole into threads of nut (and gearshaft, when gearshaft has not been previously drilled) using 0.0625 inch (1/16 inch) diameter drill. Drill hole to depth of 0.18 +0.01/-0.01 inch. Remove drill plate and check depth of drilled hole using 285998-1-1 gage. Clean off drill chips and any foreign matter using vacuum, magnet, or tape, as required.

R 4. A. (2) (e) 20) Remove protective covering from end of gearshaft. Turn gearshaft to orient drilled hole down and rinse drilled hole with solvent, trichlorotrifluoroethane (MS-180 Freon) to remove drill chips.

21) Inspect drilled hole with 10X magnification for drill chips. Remove any chips using a magnetized needle.

21a) Check drilled hole to ensure hole is not oversized using a 0.0636 inch diameter inspection gage pin. Gage pin shall not fit into hole. If hole is oversized, repeat steps 18) through 21a) using different existing half-hole in gearshaft for drilling nut. If other existing half-holes in gearshaft are unusable, or if no other half-holes exist in gearshaft threads, drill new hole approximately 45 degrees from any other half-hole in gearshaft. Any new half-holes drilled in nut shall be at least 0.150 inch from any existing half-hole in nut. Maximum allowable combined number of half-holes in gearshaft threads and nut is seven.

22) Press pin to bottom of drilled hole and stake center of pin using 284748-1-1 punch. Repeat steps 15) through 17) to properly secure pin.

23) Remove assembled parts from drill jig. Lubricate bearings with clean engine oil (72-00-00, GENERAL - SERVICING, Table 301).

(3) Replace one bearing only of planet gearshaft assembly as follows.

(a) Remove defective bearing from gearshaft as follows. (See figure 205.)

CAUTION: BEARING COMPONENTS ARE NOT INTERCHANGEABLE. ENSURE COMPONENTS OF EACH BEARING ARE KEPT TOGETHER AS A SET. OUTER AND INNER BEARING RINGS OF EACH SET ARE SERIALIZED WITH SAME NUMBER.

1) Install planet gearshaft assembly in holer portion of 289796-1 drill jig. Use protective covering (masking tape, etc.) over end of shaft and nut with defective bearing to protect assembly from drill chips and any foreign matter. Install plate of drill jig marked

R REMOVAL over end of gearshaft assembly with bearing to be replaced and with gearshaft assembly oriented to center drill guide hole in REMOVAL plate over pin in nut. (See figure 206.)

R CAUTION: WHEN PERFORMING THE FOLLOWING STEPS, ENSURE COMPLETE REMOVAL OF PIN, ANY DRILL CHIPS, AND ANY DEBRIS FROM DRILLED HOLE. PRESENCE OF ANY MATERIAL LEFT IN HOLE WILL DAMAGE THREADS AT NUT REMOVAL.

R 4. A. (3) (a) 2) Drill out pin using 0.0625 inch diameter (1/16 inch) drill to a depth of 0.230 inch. Ensure complete removal of pin and any drill chips. Clean off drill chips and any foreign matter using vacuum, magnet, or tape, as required.

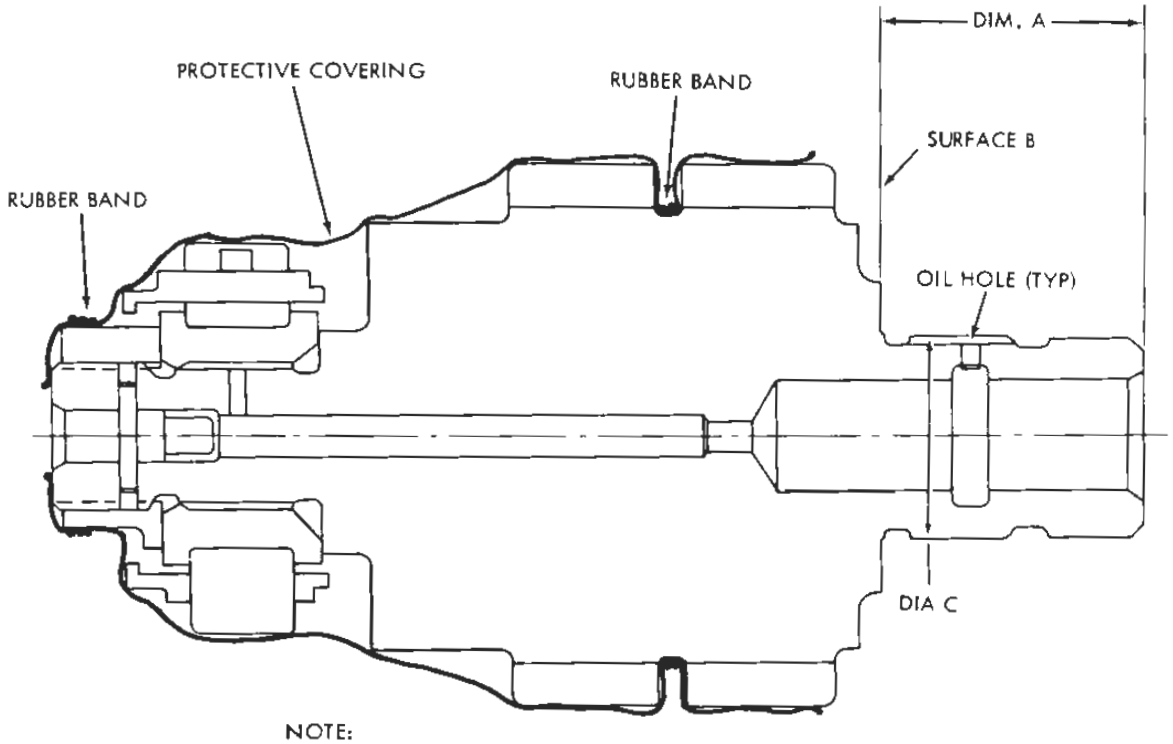
R 3) Remove REMOVAL plate of drill jig and protecive covering from end of gearshaft. Verify assembly is free of all drill chips and foreign matter using 10X magnification. Flush drilled hole with solvent, trichlorotrifluoroethane (MS-180 Freon) and use magnetized needle as required to completely clean drilled hole.

R 4) Loosen and remove nut for bearing being replaced.

R 5) Remove bearing with applicable puller in accordance with step 4.A.(2)(a)10).

R (b) Machine gearshaft to remove damage as follows.

R 1) Protect gearshaft and assembled part from contamination by installing plastic or rubber bag (approximate thickness of five mils) over opposite end of gearshaft being reworked and gear teeth of gearshaft. Secure bag with heavy rubber bands at nut for bearing still installed and at radial division of gear teeth on gearshaft. Tape over three oil holes in gearshaft surface for inner race of bearing being replaced. (See figure 209.)



NOTE:

DIMENSIONS, DIAMETERS, AND SURFACES SHOWN ARE TYPICAL FOR EITHER END OF GEARSHAFT, DEPENDING UPON WHICH BEARING IS BEING REPLACED.

F-48A-399

Machining Planet Gearshaft
Figure 209

R 4. A. (3) (b) 2) Measure and record Dimension A. (See figure 209.) Subsequent machining procedures shall not increase this dimension by more than 0.0005 inch.

3) Check radial runout of Diameter C surface (figure 209) with gearshaft located on countersunk recesses of gearshaft ends. Ensure recesses (centers) are clean and free of burrs to provide valid indications. If runout exceeds 0.0002 inch, lap diameter on centers to bring runout within limit. Lapping shall not reduce Diameter C to less than 0.7884 inch (large bearing end) or 0.5520 inch (small bearing end). Final surface finish of Diameter C shall be AA16 or better.

4) Refinish Surface B by machining in accordance with good shop practice to obtain a surface finish of AA16 or better. Machining shall not increase Dimension A recorded in step 2) by more than 0.0005 inch. If Dimension A is increased more than 0.0005 inch, continue with procedure specified in step (2) to ensure minimum value of Dimension C (figure 207) is still met. After machining to specified surface finish, face runout of Surface B with respect to centers shall not exceed 0.0002 inch.

5) Inspect reworked surfaces on gearshaft with 20X magnification. No crazing or cracks are allowed on reworked surfaces. If evident, defects may be removed in accordance with step 3) or 4) if limits of steps 3) through 5) are met after rework.

6) Clean gearshaft by flushing with 1,1,1-trichloroethane (MIL-T-81533) first with protective bag installed, then again with bag removed.

(c) Assemble planet gearshaft assembly as follows. (See figure 205.)

1) Inspect gearshaft threads and nut to be installed for burrs. Remove any burrs using rotary wire brush, burr knife, or grinding wheel, as required. Nut shall turn freely on gearshaft threads with no binding. Verify parts are free of burrs with 10X magnification.

R 4. A. (3) (c) 2) Flush gearshaft and nut with 1,1,1-trichloroethane (MIL-T-81533), then dry by blowing with compressed air.

R 3) Press bearing on gearshaft using applicable driver. Use 289804-1 driver when installing large bearing or 289803-1 driver when installing small bearing. Install inner race of bearing with chamfer on inner diameter facing gear teeth on gearshaft and with grooves on inner races turned 55 to 65 degrees from grooves on gearshaft.

R 4) Check harndess of nut to be installed. Rockwell hardness shall be RHc 28 minimum. If nut does not meet hardness requirement, discard nut failing check and repeat check for replacement nut.

R 5) Lubricate face and threads of nut with lubricating compound (Liqui-Moly, Grade NV, thread compound).

R NOTE: When performing the following step, use same nut for torque application as will be used on assembled gearshaft.

R 6) Install gearshaft in holder portion of 289796-1 drill jig and install nut. When installing nut for large bearing, tighten nut to 1150 inch-pounds torque, then loosen and retighten nut to 1150 inch-pounds torque two additional times. When installing nut for small bearing, tighten nut to 520 inch-pounds torque, then loosen and retighten nut to 520 inch-pounds torque two additional times.

R 7) Remove gearshaft from holder portion of 289796-1 drill jig. Apply clean engine oil (72-00-00, GENERAL - SERVICING, Table 301) to bearings.

R 8) Perform steps (2)(e)8) and 9) to ensure gearshaft assembly freedom of rotation and acceptable runout.

R 9) Use protective covering (masking tape, etc.) over end of gearshaft and nut for replaced bearing to protect assembly from drill chips and any foreign matter. Install drill plate of 289796-1 drill jig marked INSTALLATION over gearshaft with replaced bearing located up.

R Orient gearshaft to locate drill hole in drill
R plate over an existing half-hole in gearshaft
R threads (when gearshaft has been previously
R drilled). Ensure drill guide bushing of drill
R plate is against end of gearshaft assembly to
R prevent any wobble of drill during drilling
R operation.

R 4. A. (3) (c) 10) Drill hole into threads of nut (and gearshaft,
R when gearshaft has been previously drilled)
R using 0.0625 inch (1/16 inch) diameter drill.
R Drill hole to depth of 0.18 +0.01/-0.01 inch.
R Remove drill plate and check depth of drilled
R hole using 285998-1-1 gage. Clean off chips
R and any foreign matter using vacuum, magnet,
R or tape, as required.

R 11) Remove protective covering from end of
R gearshaft. Turn gearshaft to orient drilled
R hole down and rinse drilled hole with solvent,
R trichlorotrifluoroethane (MS-180 Freon) to
R remove drill chips.

R 12) Inspect drilled hole with 10X magnification
R for drill chips. Remove any chips using a
R magnetized needle.

R 12a) Check drilled hole to ensure hole is not over-
R sized, using a 0.0636 inch diameter inspection
R gage pin. Gage pin shall not fit into hole.
R If hole is oversized, repeat steps 9) through
R 12a) using a different existing half-hole in
R gearshaft for drilling nut. If other existing
R half-holes in gearshafts are unusable, or if
R no other half-holes exist in gearshaft
R threads, drill new hole approximately 45 de-
R grees from any other half-hole in gearshaft.
R Any new half-hole drilled in nut shall be at
R least 0.150 inch from any existing half-hole
R in nut. Maximum allowable combined number of
R half-holes in gearshaft threads and nut is
R seven.

R 13) Press pin to bottom of drilled hole and stake
R center of pin using 285748-1-1 punch.

R 14) Remove stylus from 285748-1-1 punch and in-
R stall 294681-1 adapter in place of removed
R stylus.

R 15) Centerstake hole for pin using 285748-1-1
R punch and 294681-1 adapter to displace nut and
R gearshaft material around perimeter of pin.

Ensure nut and gearshaft material is displaced to secure pin.

4. A. (3) (c) 16) Remove 294681-1 adapter from 285748-1-1 punch and reinstall stylus removed in step 14).

17) Remove assembled parts from drill jig. Lubricate bearings with clean engine oil (72-00-00, GENERAL - SERVICING, Table 301).

B. Replace Defective Rivets and/or Nutplates on Retainer Plate (See Figure 201)

(1) Drill out loose or damaged rivets or rivets securing defective nutplates.

(2) Secure serviceable nutplates with rivets. Install rivets in accordance with good shop practice.

C. Replace Bearing Portion of Pinion Gear Assembly (See Figure 201)

CAUTION: USE CARE NOT TO DAMAGE BEARING OF PINION GEAR ASSEMBLY WHEN PERFORMING THE FOLLOWING INSTRUCTIONS. PROTECT BEARING FROM HANDLING DAMAGE AND FROM METAL CHIPS OR OTHER FOREIGN MATTER.

(1) Disassemble pinion gear assembly as follows.

(a) Position rollers of bearing out into cage of bearing to allow removal. Remove rollers and cage of bearing from bearing inner race.

(b) Install pinion gearshaft in 289835-1 fixture. Install drill jig portion of 289835-1 fixture.

(c) Drill out pin of pinion gear assembly using a 0.0635-inch diameter drill. Drill to a depth of 0.0240 inch to ensure complete removal of pin. Remove drill jig portion of 289835-1 fixture.

(d) Remove nut from pinion gearshaft using 289835-1 fixture. Remove inner race of bearing from pinion gearshaft using 289836-1 bearing puller.

R 4. C. (2) Assemble pinion gear assembly as follows.

R NOTE: Refer to 70-00-00, STANDARD PRACTICES
R for general torque values. Add frictional drag (run-down) torque of self-
R locking devices to recommended values.

R (a) Position rollers of bearing out into cage of bearing to allow removal. Remove rollers and cage of
R bearing from bearing inner race.

R (b) Install inner race of bearing on gearshaft and install nut. Orient bearing race so serial-numbered
R side of race faces out.

R (c) Install assembled gearshaft, bearing inner race, and nut in 289835-1 fixture. Tighten nut to
R torque of 400 to 500 inch-pounds. Loosen nut and repeat torque application two additional times to
R properly seat inner race of bearing.

R (d) Install drill jig portion of 289835-1 fixture and drill 0.0625 +0.0010/-0.0010 inch diameter hole to
R a depth of 0.018 +0.01/-0.01 inch in nut and gearshaft threads for pin installation. When parts
R have been previously drilled for pin hole, drill new hole approximately 45 degrees from any existing holes. Check depth of hole using 285998-1-1
R gage.

R (e) Press pin to bottom of hole drilled in previous step and stake center of pin using 285748-1-1
R punch.

R (f) Remove stylus from 285748-1-1 punch and install 294681-1 adapter in place of removed stylus.

R (g) Centerstake hole for pin using 285748-1-1 punch and 294681-1 adapter to displace nut and gearshaft material around perimeter of pin. Ensure nut and
R gearshaft material is displaced to secure pin.

R (h) Remove 294681-1 adapter from 285748-1-1 punch and reinstall stylus removed in step (f).

R (i) Thoroughly clean assembled components of any metal chips from drilling operation and any foreign
R matter.

R (j) Install rollers and cage of bearing over nut and onto bearing inner race.

R 4. D. Replace Missing or Broken Dowel Pins of Intermediate Case Assembly Used for Locating Aft Flange of Planet Gear Assembly

(1) Check hole size at location of broken or missing dowel pin. Do not attempt repair if hole size is greater than 0.3748 inch.

(2) If portion of dowel pin is present in dowel pin hole, drill dowel pin using a carbide drill and remove remainder of dowel pin using an easy-out type tool. Use a drill stop to limit drill depth to 0.5 inch. Use care not to damage hole.

(3) Touch up interior of hole using chromate conversion coating solution. (Refer to 72-00-00, Cleaning/Painting.)

(4) Press in replacement dowel pin to full depth. Protrusion of pin above surface of intermediate case assembly shall be 0.330 to 0.340 inch.

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	204	Apr 30/80
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	207	Apr 30/80
	208	Blank

RECORD OF TEMPORARY REVISIONS

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CHAPTER 73 - ENGINE FUEL AND CONTROL

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GENERAL - DESCRIPTION AND OPERATION

1. Engine Fuel and Control

Fuel from the aircraft fuel system is pumped through the engine fuel system by the fuel pump, filtered, metered by the fuel control, delivered to the combustion chamber by the fuel manifold and atomized for efficient combustion by the fuel nozzles. The fuel pump is mounted on the aft side of the accessory drive gearbox and provides the drive for the fuel control. The fuel control function is accomplished by the engine-mounted fuel control and by the electronic computer located in the airframe. The flow divider and drain valve (or flow divider valve) provides primary and secondary fuel flows to the fuel manifold assembly. Primary fuel flow is provided during starts and secondary fuel flow is supplied as fuel flow requirements increase.

DISTRIBUTION - DESCRIPTION AND OPERATION

1. Fuel Manifold Assembly

   The fuel manifold assembly is mounted on the combustion chamber plenum case, and delivers fuel to the combustion chamber through twelve nozzles.

2. (Codes A, C) Fuel Heater and Filter De-Icing Valve

   The function of the filter de-icing valve is to monitor boost-pump discharge fuel temperature downstream of the filter element and mix warm fuel from the fuel heater with the boost-pump discharge flow to prevent icing of the filter element. The fuel heater is covered in 79-20-06.

3. Oil Temperature Regulator (Fuel/Oil Cooler)

   The oil temperature regulator (fuel/oil cooler) receives metered fuel directly from the fuel control. The primary purpose is to cool the oil prior to its entry to the fan reduction section. The fuel/oil cooler is covered in 79-20-07.

FUEL MANIFOLD INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Materials and Compounds

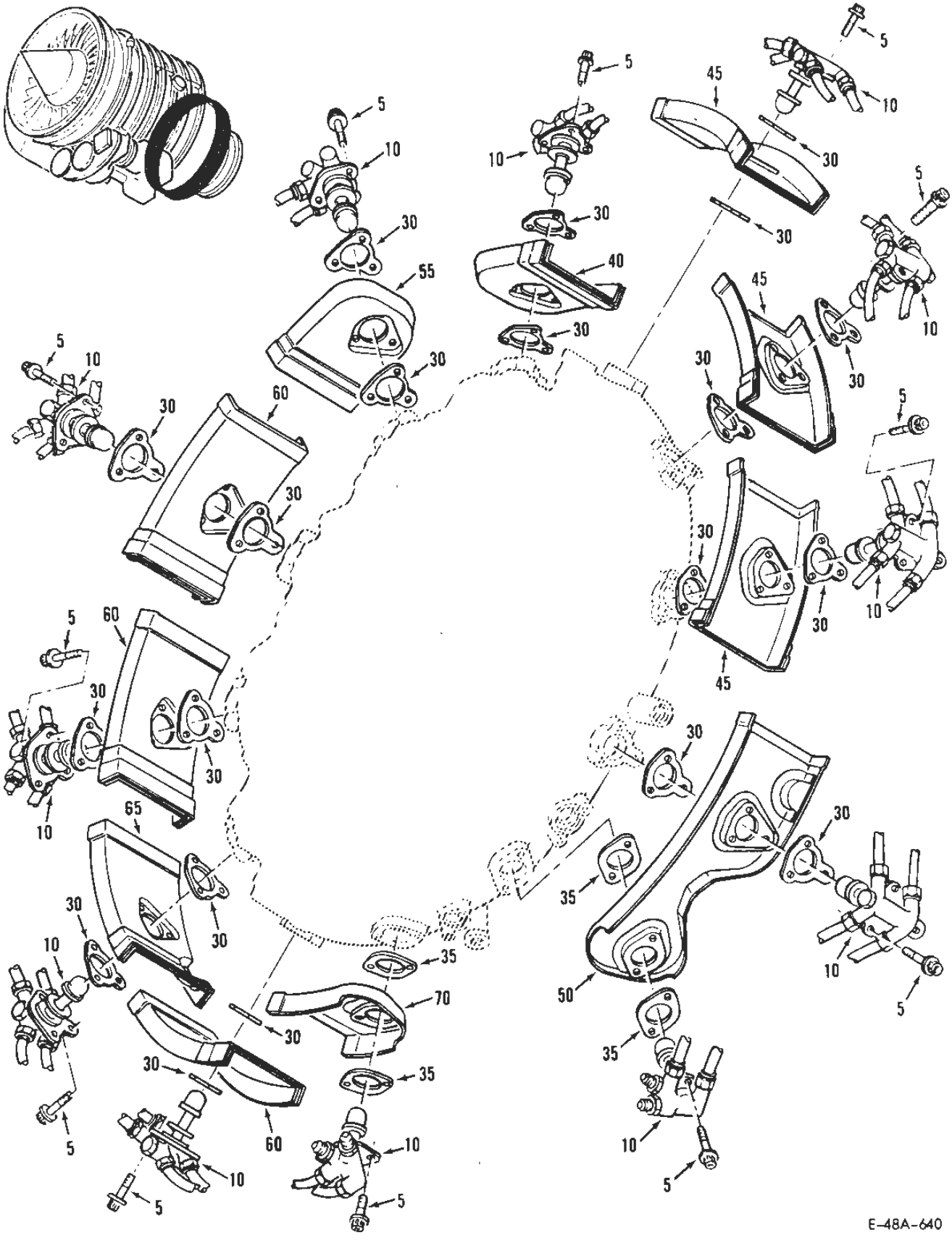
Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
High temperature compound (Fel-Pro C5-A)	Fel-Pro Inc, Div of Felt Products Mfg Co, 7450 N McCormick Blvd, Skokie, IL 60076

A. Remove Fuel Manifold Assembly (See Figure 201)

(1) Disconnect manifold assemblies from branched fuel line manifold. Remove bolts securing manifold assemblies to combustion chamber plenum case.

CAUTION: HANDLE MANIFOLD ASSEMBLY WITH CARE AT REMOVAL TO PREVENT BREAKING OR DAMAGING BOSSES.

(2) Remove manifold assemblies, starting at top of engine and working toward bottom of engine. Remove gaskets and shield segments. R



R

Fuel Manifold Installation
Figure 201

R

NOTE: Fuel manifold assemblies comprise a matched set. If replacement is required, both halves shall be replaced as a set.

1. B. Install Fuel Manifold Assembly (See Figure 201)

CAUTION: ENSURE FUEL NOZZLE GROMMETS (ON COMBUSTION CHAMBER LINER WITHIN PLENUM CASE) ARE IN PLACE BEFORE INSTALLING COMPONENTS.

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

R A short dowel pin or bolt may be used to
R facilitate aligning bolt holes in shield segments, gasket bodies, gaskets, and manifolds during installation.

Torque value for attaching bolts on fuel nozzle bodies varies with part number of gaskets used. Note part number at installation of gaskets.

R (1) Install shield segments and new gaskets. If metal-reinforced gaskets were removed at disassembly and are seviceable, gaskets may be re-used. Do not re-use gaskets without metal-reinforcing. Refer to Service Bulletins 73-3015 and 73-3016.

KEY TO FIGURE 201

5. BOLT (IPC FIG. 27)
10. MANIFOLD ASSY
30. GASKET
35. GASKET
40. SHIELD SEGMENT
45. SHIELD SEGMENT
50. SHIELD SEGMENT
55. SHIELD SEGMENT
60. SHIELD SEGMENT
65. SHIELD SEGMENT
70. SHIELD SEGMENT

CAUTION: WHEN INSTALLING MANIFOLD ASSEMBLY, ENSURE SHARP EDGES ON SHIELD SEGMENTS DO NOT CONTACT MANIFOLD ASSEMBLY TUBING. IF REQUIRED, BEND SHIELD SEGMENTS TO CLEAR TUBING. WHEN INSTALLING NOZZLE BODIES ON PLENUM, HOLD NOZZLE BODY FIRMLY DOWN BY HAND PRESSURE. DO NOT DRAW NOZZLE BODY INTO PLENUM WITH BOLTS. OBSERVE SPECIFIED TORQUE TO PRECLUDE BENDING OF FLANGES ON NOZZLE BODIES.

NOTE: Fuel manifold assemblies comprise a matched set. If replacement is required both halves shall be replaced as a set.

Torque value for bolts (5) in the following step is 60 inch-pounds when 3071251-1 and 3071252-1 gaskets (without metal reinforcing) are used.

1. B. (2) Position manifold assemblies on combustion chamber plenum case. Coat threads of bolts to secure manifold assemblies on engine with high temperature compound (Fel-Pro C5-A). Install and tighten bolts (5). When using gaskets with metal reinforcing (3072629-1 and 3072630-1 gaskets or 3072629-2 and 3072630-2 gaskets), tighten bolts (5) to torque of 45 inch-pounds.

(3) Connect manifold assemblies to branched fuel line manifold.

2. Inspection/Check

A. Inspect Fuel Manifold Assembly

(1) Inspect fuel manifold assembly for security and evidence of leakage.

(2) Inspect flexible hose assembly for fraying or evidence of chafing. Replace defective hose assemblies in accordance with 4, Approved Repairs.

(3) Inspect shield segments for broken welds, cracks, or missing pins.

(4) Inspect fuel nozzle bodies as follows. (See figure 202.)

(a) Visually inspect extensions on nozzle bodies which hold spring pins for cracks or other damage.

2. A. (4) (b) Visually inspect mounting surfaces which mate with gaskets. Surface shall not be bowed or deformed
R in excess of 0.027 inch. Refer to 4, Approved Repairs if mounting surface is bowed or deformed.

(5) Replace fuel manifold assembly if inspection requirements of steps (1) through (4) are not met and damage is beyond the scope of 4, Approved Repairs.

(6) Inspect assembled fuel nozzle shrouds (installed at each fuel nozzle) for excessive erosion of material or
R damage as follows.

(a) (Shrouds with cooling slots) Some loss of material is allowable (minimum material thickness in area near cooling slots is 0.035 inch); however, cracks are not permitted, and widths of cooling slots may not exceed 0.13 inch. Figure 203 compares a non-eroded shroud to shrouds with unacceptable damage.

(b) (Shrouds with round cooling holes) Some loss of material is allowable; however, cracks are not permitted and complete erosion of material between adjacent cooling holes is not permitted. Figure 204 compares a non-eroded shroud to a shroud with unacceptable erosion between cooling holes.

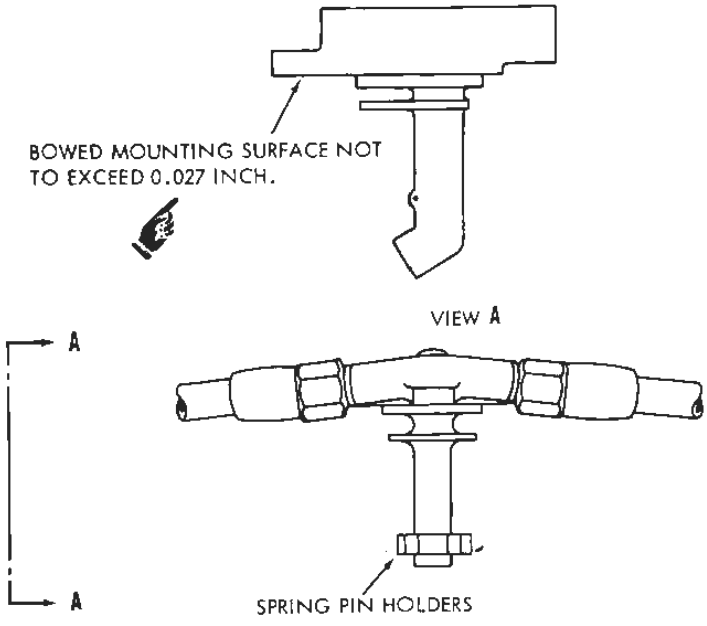
(c) Buckling or distortion of shroud (top part of shroud should be spherical and bottom part cylindrical) is not permitted.

(d) If requirements of steps (a), (b), and (c) are not met, remove and replace pins securing defective shrouds and defective shrouds in accordance with 4, Approved Repairs.

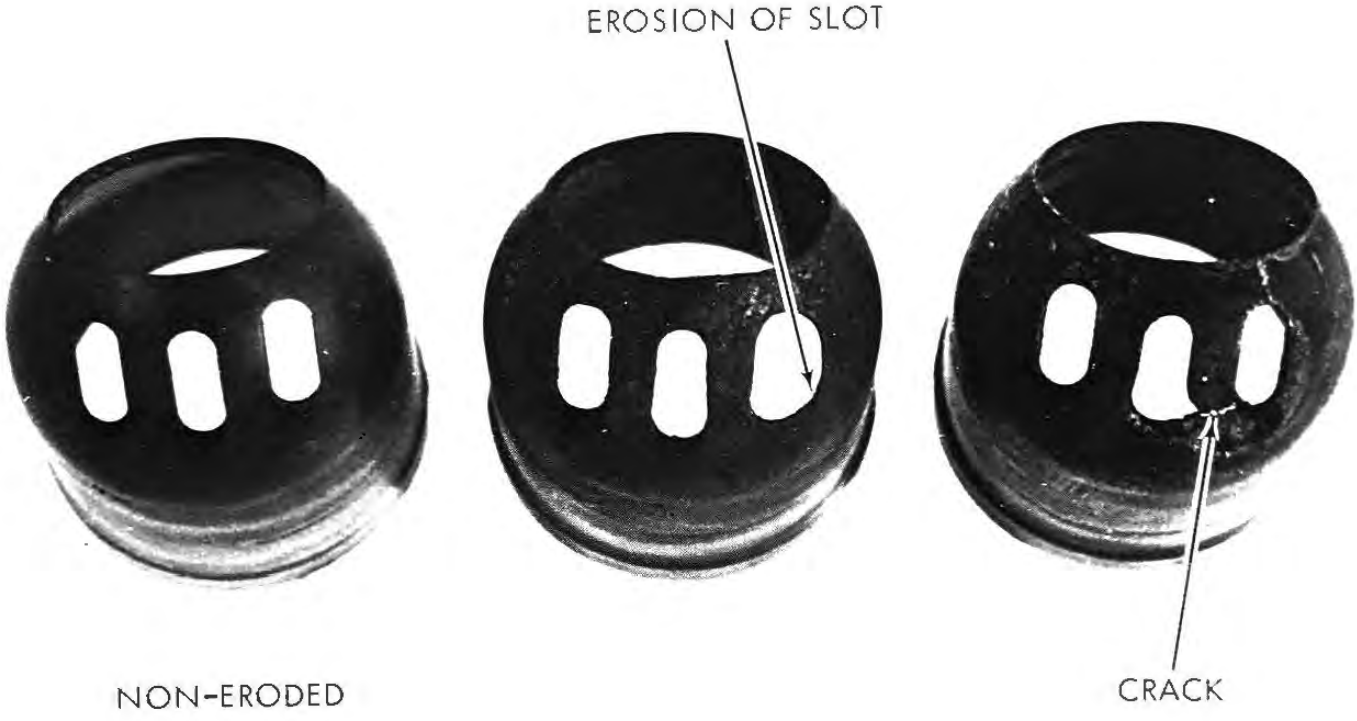
R (7) Inspect assembled fuel nozzle swirl assemblies as
R follows. (See figure 205.)

(a) Inspect swirl assemblies for any erosion of material. A swirl assembly with an excessive amount of erosion is shown in Figure 205 with an assembly having no erosion. Erosion usually appears as an increase in diameter of aperture at end of swirl assembly. Maximum permissible diameter of aperture is 0.390 inch.

(b) Replace fuel manifold assembly if erosion of any swirl assembly is beyond acceptable limits of step (a).



Inspection of Fuel Nozzle Body
Figure 202



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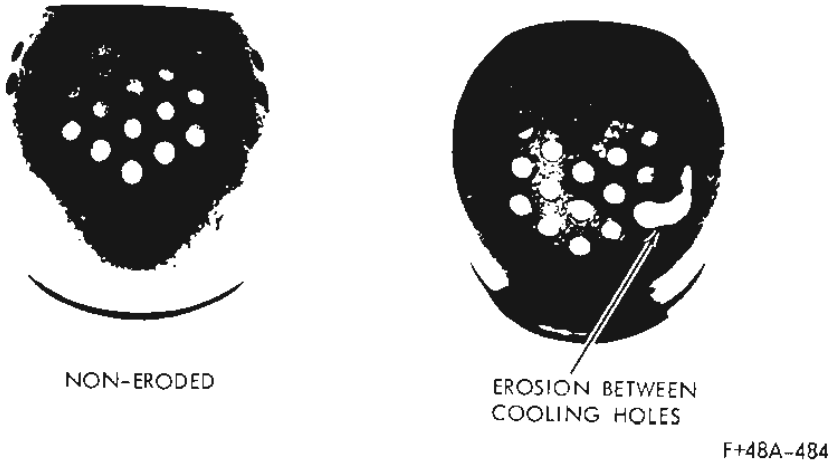
Fuel Nozzle Shroud (With Cooling Slots)
Figure 203



Fuel Nozzle Shrouds (With Round Cooling Holes)
Figure 204

NON-ERODED

EROSION

F-48A-104

Fuel Nozzle Swirl Assemblies
Figure 205

3. Cleaning/Painting

Table 202. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Suede brush (1630-210)	Los Angeles Brush Co, 2137 E 37th St, Los Angeles, CA

A. Clean Parts

(1) Clean parts as specified in Table 203 in accordance with cleaning methods provided in 72-00-00, GENERAL-CLEANING/PAINTING.

Table 203. Cleaning Methods

Figure No.	Item No.	Nomenclature	Cleaning Methods 1	2	3	4	5	6	7	8	9	10	11	12
All standard metallic hardware			X	X										
Plumbing and fittings														X
201	10	Manifold Assy	Refer to step 3.A.(2)											
	40 thru 70	Shield Segment	X	X							X			

3. A. (2) Clean fuel manifold assembly halves as follows.

CAUTION: USE ONLY 10-MICRON FILTERED DRY AIR OR NITROGEN WHEN PRESSURIZING FUEL MANIFOLD ASSEMBLY IN THE FOLLOWING PROCEDURE TO PREVENT CONTAMINATION OF FUEL MANIFOLD ASSEMBLY. DO NOT CLEAN FUEL NOZZLES WITHOUT AIR OR NITROGEN FLOWING THROUGH NOZZLES.

(a) On one of the fuel manifold assembly halves, connect source of 10-micron filtered dry air or nitrogen at pressure of 100 psig to both primary and secondary fuel input connections.

(b) Using brass, soft bristled, suede brush (1630-210), clean carbon from fuel nozzle tips.

(c) Shut off air or nitrogen source and disconnect lines to primary and secondary fuel inputs.

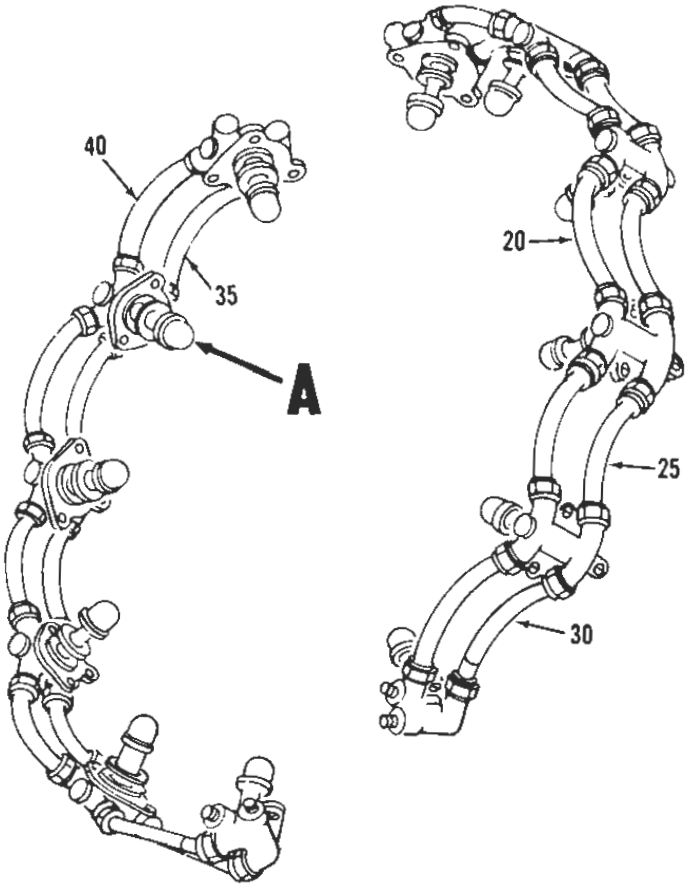
(d) Visually inspect each fuel nozzle tip to ensure no fibers from brush used for cleaning or any other foreign matter remain on tips. If any fibers or foreign matter is observed, repeat step (a) through (d) to ensure clean nozzle tips.

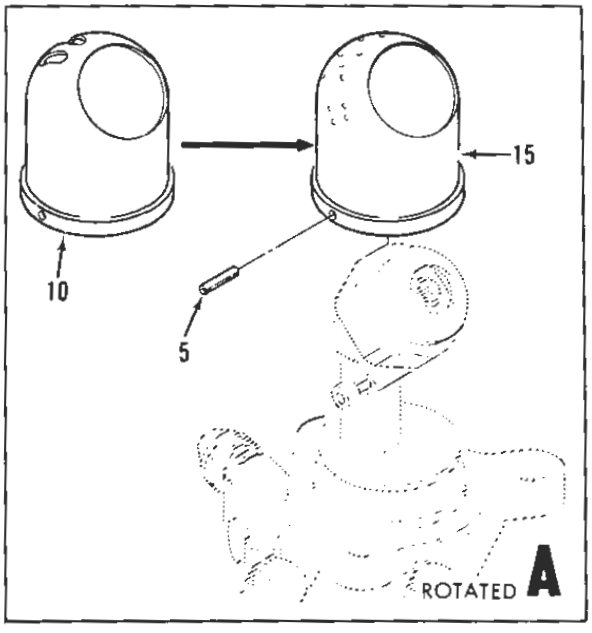
(e) Repeat steps (a) through (d) on second fuel manifold assembly half.

4. Approved Repairs

Table 204. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Penetrating oil (WD-40)	WD-40 Co, 1061 Cudahy Place, San Diego, CA 92110





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Flexible Hose Assembly and Fuel Nozzle Shroud Replacement
Figure 206

Table 205. Special Tools, Fixtures and Equipment

Item No.	Nomenclature	Use	Source Part No.
NOTE: Equivalent substitutes may be used for listed items.			
1.	Manifold Holder Set	Supports fuel nozzle body for spring pin removal/ installation.	293317-1

4. A. Repair Fuel Manifold Assembly by Replacing Burned, Eroded, or Cracked Fuel Nozzle Shrouds (See Figure 206)

NOTE: Prevent penetrating oil from getting into fuel nozzle tip when performing the following step.

(1) Use penetrating oil (WD-40) to spray spring pins to facilitate spring pin removal.

KEY TO FIGURE 206

5.	SPRING PIN (IPC FIG. 28)	25.	FLEXIBLE HOSE ASSY
R 10.	SHROUD (PRE SB73-3014)	30.	FLEXIBLE HOSE ASSY
R 15.	SHROUD (POST SB73-3014)	35.	FLEXIBLE HOSE ASSY
R 20.	FLEXIBLE HOSE ASSY	40.	FLEXIBLE HOSE ASSY

CAUTION: WHEN REMOVING SPRING PINS, 293317-1 MANIFOLD HOLDER SET SHALL BE USED TO SUPPORT ARMS ON FUEL NOZZLE BODY TO PRECLUDE BREAKING.

4. A. (2) Using a fine point punch, ground to a 45 degree angle, drive spring pins out to remove shroud. Support fuel nozzle body with 293317-1 manifold holder set to avoid damage when removing spring pins.

(3) Install new shroud using new spring pins. Install same type of shroud as removed. Earlier type shroud has slotted cooling holes. Later type shroud has round cooling holes. If spring pin is loose, remove and increase diameter slightly, then reinstall to ensure a tight fit.

B. Repair Bowed or Deformed Nozzle Body

CAUTION: DURING REPAIR OF DEFORMED MOUNTING FLANGES, EXERCISE EXTREME CARE TO PREVENT DAMAGE TO GASKET SEALING SURFACE OF NOZZLE BODY. AFTER BENDING NOZZLE BODY MOUNTING FLANGE, PERFORM CAREFUL VISUAL INSPECTION FOR CRACKS.

(1) Repair bowed or deformed mounting flanges of nozzle bodies by bending mounting flange. After repair, surR face shall not be bowed or deformed in excess of 0.027 inch.

(2) Inspect nozzle body for cracks. Replace fuel manifold assembly if part is cracked.

C. Replace Damaged Flexible Hose Assembly

CAUTION: MANIFOLD HALVES ARE MATCHED SETS. ONLY SPECIFIED PARTS MAY BE REPLACED AT FIELD LEVEL IN LIEU OF REPLACING COMPLETE FUEL MANIFOLD ASSEMBLY.

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

R (1) Replace damaged flexible hose assembly as follows. (See figure 206.)

NOTE: Assembled twist angle between adjacent nozzles shall not exceed 10 degrees and the accumulated twist angle between the end nozzles shall not exceed 45 degrees. Install nozzle bodies in the same position from which they were removed.

R 4. C. (1) (a) Install Flexible Hose Assembly (20, 40). Tighten nuts on flexible hose assembly to torque of 120 inch-pounds, then lockwire.

R (b) Install Flexible Hose Assembly (25, 35). Tighten nuts on flexible hose assembly to torque of 80 inch-pounds, then lockwire.

R (c) Install Flexible Hose Assembly (30). Tighten nuts on flexible hose assembly to torque of 80 inch-pounds, then lockwire.

WARNING: AREAS IN PROXIMITY OF ENGINE INLET AND EXHAUST ARE EXTREMELY HAZARDOUS TO PERSONNEL WHEN ENGINES ARE OPERATING. PERSONNEL SHALL CLEAR THESE AREAS DURING START AND OPERATION TO AVOID INJURY.

(2) After installation of flexible hose assembly, run engine in accordance with Aircraft Flight Manual to check for leakage and distortion of hoses.

FUEL AND P3 SENSING LINES INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

   A. Remove Fuel and P3 Sensing Lines

      (1) (Code A) Disconnect electrical connectors and remove clamps of engine wiring harness installation from gearbox components in accordance with 72-00-02, MAINTENANCE PRACTICES.

      (2) Remove fuel and oil pressure sensing lines of fuel/oil cooler installation in accordance with 79-20-07, MAINTENANCE PRACTICES. (See 79-20-07, figure 201 or 202, as applicable.)

      (3) (Codes A, C) Remove fuel tubes from fuel heater in accordance with 79-20-06, MAINTENANCE PRACTICES.

      (4) Remove tubes from oil tank to oil pump and accessory drive gearbox in accordance with 79-10-01, MAINTENANCE PRACTICES.

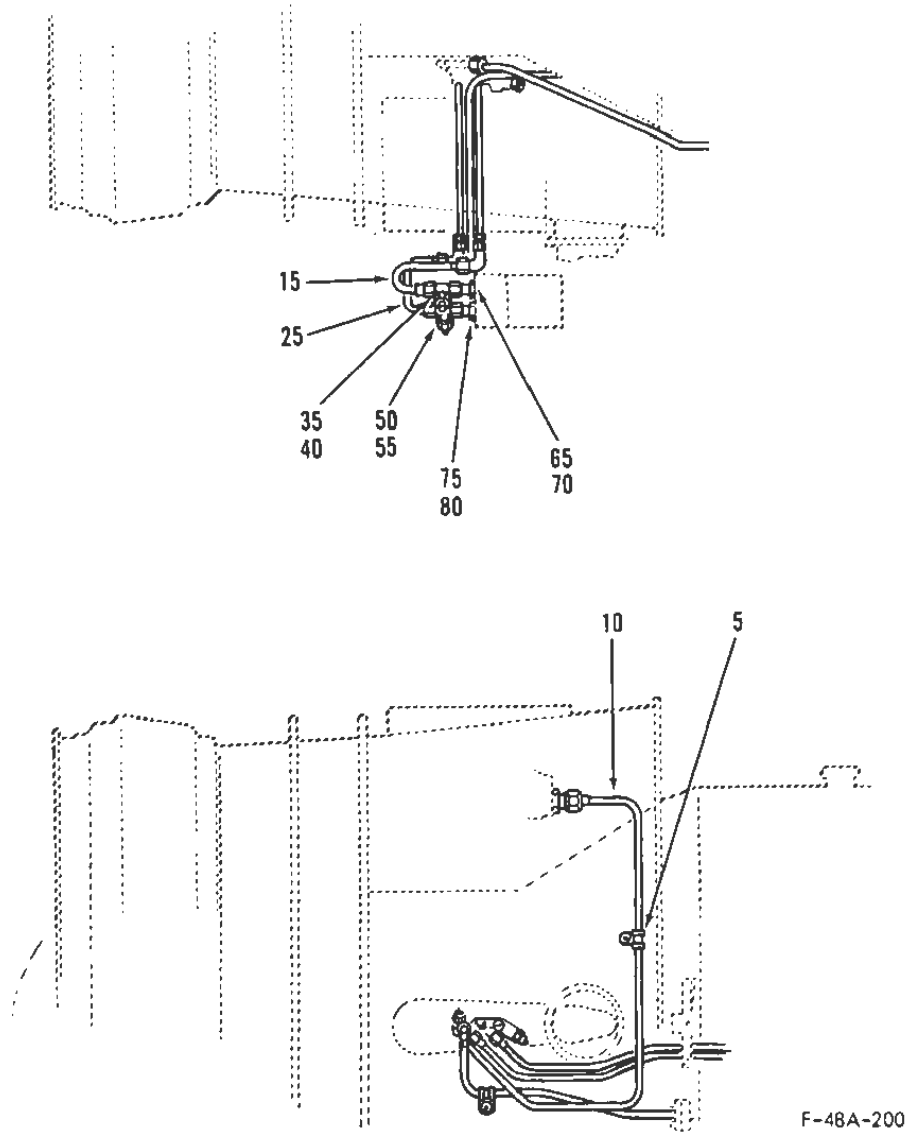
      (5) Remove nut securing clamp on outer P3 pneumatic tube assembly at mounting flange for transfer gearbox; remove clamp and reinstall nut. (See figure 201.) Remove outer P3 pneumatic tube assembly.

      (6) Remove fuel tubes, tees and caps (if installed), and unions and packings providing connections from bottom duct rib to flow divider and drain valve (or flow divider valve). (See figure 201.)

   B. Install Fuel and P3 Sensing Lines (See Figure 201)

      NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

      (1) Install fuel tubes, tees and caps (if used), and unions and packings to connect elbows at bottom duct rib and flow divider and drain valve (or flow divider valve). (See figue 201.)



5.	CLAMP (IPC FIG. 24)	50.	CAP (PART ADDED)
10.	OUTER P3 PNEUMATIC TUBE ASSY	55.	TEE (PART ADDED)
15.	SECONDARY FUEL TUBE ASSY	65.	UNION
25.	PRIMARY FUEL TUBE ASSY	70.	PACKING
35.	CAP (PART ADDED)	75.	UNION
40.	TEE (PART ADDED)	80.	PACKING

Fuel and P3 Sensing Lines Installation
Figure 201

1. B. (2) Install outer P3 pneumatic tube assembly from elbow at bottom duct rib to fuel control. Secure tube assembly with clamp under nut at mounting flange for transfer gearbox. (See figure 201.) Tighten nut (50, figure 201, 72-60-01) at mounting flange of transfer gearbox to torque of 100 inch-pounds.

(3) Install tubes from oil tank to oil pump and accessory drive gearbox in accordance with 79-10-01, MAINTENANCE PRACTICES.

(4) (Codes A, C) Install fuel tubes from fuel heater in accordance with 79-20-06, MAINTENANCE PRACTICES.

(5) Install fuel and oil pressure sensing lines of fuel/oil cooler installation in accordance with 79-20-07, MAINTENANCE PRACTICES. (See 79-20-07, figure 201 or 202, as applicable.)

(6) (Code A) Connect electrical connectors and install clamps of engine wiring harness installation on gearbox components in accordance with 72-00-02, MAINTENANCE PRACTICES.

2. Inspection/Check

A. Inspect Tubing

Inspect tubing for dents. Replace dented tubing if dent causes a crease or reduces diameter more than ten percent.

3. Cleaning/Painting

A. Clean Parts

Clean tubing as specified in 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method No. 12.

SERVICE TUBES CLAMP AND TUBES INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Materials and Compounds

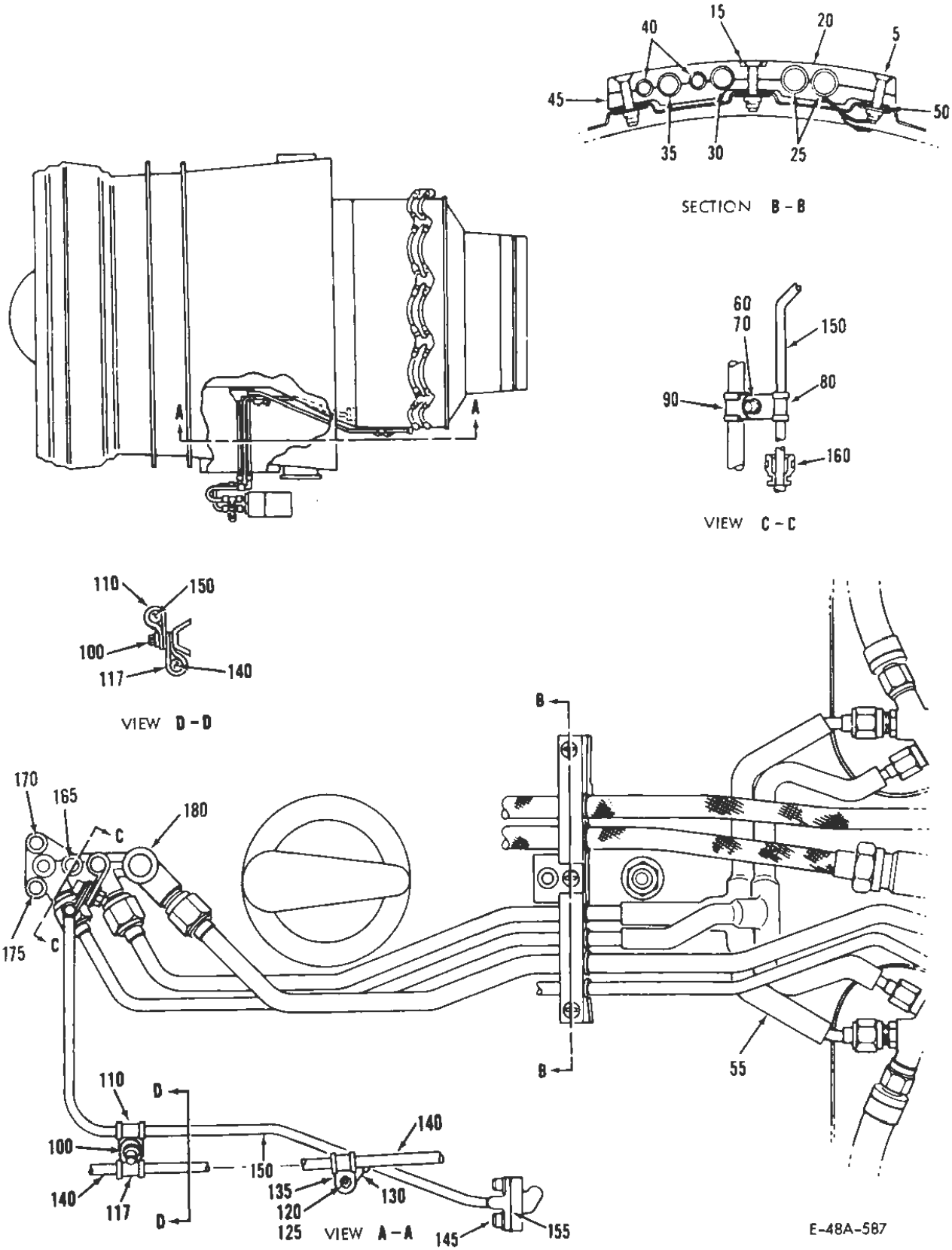
Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
High temperature compound (Fel-Pro C5-A)	Fel-Pro Inc, Div of Felt Products Mfg Co, 7450 N McCormick Blvd, Skokie, IL 60076
Lubricating compound (Liqui-Moly, Grade NV, Thread Compound)	Lockrey Co, Lubricants Div, Cedar Shores, Southampton, NY 11968

A Remove Service Tubes Clamp and Tubes

(1) (Code A) Disconnect electrical connectors and remove clamps of engine wiring harness installation from gearbox components in accordance with 72-00-02, MAINTENANCE PRACTICES.

(2) Remove fuel and oil pressure sensing lines of fuel/oil cooler installation in accordance with 79-20-07, MAINTENANCE PRACTICES. (See 79-20-07, figure 201 or 202, as applicable.)

(3) (Codes A, C) Remove fuel tubes from fuel heater in accordance with 79-20-06, MAINTENANCE PRACTICES.



Service Tubes Clamp and Tubes Installation
Figure 201

1. A. (4) Remove tubes from oil tank to oil pump and accessory drive gearbox in accordance with 79-10-01, MAINTENANCE PRACTICES.

(5) Remove nut securing clamp on outer P3 pneumatic tube assembly at mounting flange for transfer gearbox; remove clamp and reinstall nut. (See 73-10-02.) Remove outer P3 pneumatic tube assembly.

(6) Remove fuel tubes, tees and caps (if installed), and unions and packings providing connections from bottom duct rib to flow divider and drain valve (or flow divider valve). (See 73-10-02.)

(7) Remove fuel system installation in accordance with 73-20-01, MAINTENANCE PRACTICES.

(8) Remove oil pump and chip detector installation in accordance with 79-20-03, MAINTENANCE PRACTICES.

(9) Remove accessory and transfer gearbox installation in accordance with 72-60-01, MAINTENANCE PRACTICES.

(10) Remove oil tube from oil temperature regulator (fuel/oil cooler) to bottom duct rib in accordance with 79-20-07, MAINTENANCE PRACTICES. (See 79-20-07, figure 203.)

KEY TO FIGURE 201

5.	SCREW (IPC FIG. 29)	100.	BOLT
15.	PLATE	110.	CLAMP
20.	LOWER HALF SERVICE TUBES CLAMP	117.	CLAMP
25.	HALF SLEEVE	120.	NUT
30.	HALF SLEEVE	125.	BOLT
35.	HALF SLEEVE	130.	CLAMP
40.	HALF SLEEVE	135.	CLAMP
45.	UPPER HALF SERVICE TUBES CLAMP	140.	NO. 6 BEARING LUBE TUBE ASSY
R 50.	WASHER	145.	BOLT
55.	FUEL LINE MANIFOLD (BRANCHED)	150.	INNER P3 PNEUMATIC TUBE
60.	NUT	155.	GASKET
70.	BOLT	160.	PACKING
80.	CLAMP	165.	BOLT (IPC FIG. 58)
90.	CLAMP	170.	BOLT
		175.	BOLT
		180.	FUEL LINE MANIFOLD (INNER)

1. A. (11) Remove bottom duct rib, bottom panel, and right side panel in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figures 202 and 203.)

(12) Remove lower right-side oil (air/oi) cooler in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 204 or 205, as applicable.)

(13) Remove nuts, bolts, and clamps securing inner P3 pneumatic tube. (See figure 201.) Remove inner P3 pneumatic tube, packings, and gasket.

(14) Remove screws securing service tubes clamps to engine. Remove tee plate, lower service tube clamp, and lower half sleeves. (See figure 201.)

(15) Disconnect and remove branched fuel line manifold. (See figure 201.)

(16) Disconnect oil tube and remove bolts securing inner fuel line manifold. Remove inner fuel line manifold.

(17) Remove upper service tubes clamp, washers, and upper half sleeves.

B. Install Service Tubes Clamp and Tubes (See figure 201)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Apply a light coat of lubricating compound (Liqui-Moly, Grade NV, thread compound) to threads of bolts for securing inner fuel line manifold. Position inner fuel line manifold on engine, connect oil tube, and secure with bolts. Tighten bolts (165, 170, 175) to torque of 60 inch-pounds.

(2) Apply a light coat of high temperature compound (Fel-Pro C5-A) to threads of screws for securing service tube clamps. Assemble branched fuel line manifold, service tube clamps, washers, half sleeves, and tee plate, then secure with screws. Tighten screws (5) to torque of 40 inch-pounds.

(3) Coat threads of bolts used to secure inner P3 pneumatic tube to plenum case with high temperature compound (Fel-Pro C5-A). Install inner P3 pneumatic tube with new gasket and packing and secure to plenum case with bolts. Tighten bolts (145) to torque of 50 inch-pounds.

1. B. (4) Install clamps to secure P3 pneumatic tube and secure with bolts and nuts. Tighten bolts (70, 100, 125) to torque of 50 inch-pounds.

(5) Install lower right-side oil (air/oil) cooler in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 204 or 205, as applicable.)

(6) Install right-side panel, bottom panel, and bottom duct rib in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figures 202 and 201.)

(7) Install oil tube from oil temperature regulator (fuel/oil cooler) to bottom duct rib in accordance with 79-20-07, MAINTENANCE PRACTICES. (See 79-20-07, figure 203.)

(8) Install accessory and transfer gearbox installation in accordance with 72-60-01, MAINTENANCE PRACTICES.

(9) Install oil pump and chip detector installation in accordance with 79-20-03, MAINTENANCE PRACTICES.

(10) Install fuel system installation in accordance with 73-20-01, MAINTENANCE PRACTICES.

(11) Install fuel tubes, tees and caps (if used), and unions and packings to connect elbows at bottom duct rib and flow divider and drain valve (or flow divider valve). (See 73-10-02.)

(12) Install outer P3 pneumatic tube assembly from elbow at bottom duct rib to fuel control. Secure tube assembly with clamp under nut at mounting flange for transfer gearbox. (See 73-10-02.) Tighten nut (50, figure 201, 72-60-01) at mounting flange of transfer gearbox to torque of 100 inch-pounds.

(13) Install tubes from oil tank to oil pump and accessory drive gearbox in accordance with 79-10-01, MAINTENANCE PRACTICES.

(14) (Codes A, C) Install fuel tubes from fuel heater in accordance with 79-20-06, MAINTENANCE PRACTICES.

(15) Install fuel and oil pressure sensing lines of fuel/oil cooler installation in accordance with 79-20-07, MAINTENANCE PRACTICES. (See 79-20-07, figure 201 or 202, as applicable.)

1. B. (16) (Code A) Connect electrical connectors and install clamps of engine wiring harness installation on gearbox components in accordance with 72-00-02, MAINTENANCE PRACTICES.

2. Inspection/Check

   A. Inspect Tubing

      Inspect tubing for dents. Replace dented tubing if dent causes a crease or reduces diameter more than ten percent.

3. Cleaning/Painting

   A. Clean Parts

      Clean parts as specified in Table 202 in accordance with cleaning methods provided in 72-00-00, GENERAL - CLEANING/PAINTING.

Table 202. Cleaning Methods

Figure No.	Item No.	Nomenclature	Cleaning Methods 1	2	3	4	5	6	7	8	9	10	11	12
All standard metallic hardware			X	X										
Plumbing and fittings														X
201	20	Clamp	X	X			X	X						
	45	Clamp	X	X			X	X						

CONTROLLING - DESCRIPTION AND OPERATION

1. General

The fuel control system incorporates the fuel control, fuel pump, and flow divider and drain valve (or flow divider valve).

The fuel control, attached to the rear of the fuel pump, is driven by the fuel pump shaft. The fuel control incorporates a power lever shaft, overspeed solenoid, shutoff valve, outlet pressure regulator, compressor discharge limiter, flyweight governor, inlet pressure regulator, servo pressure valve, torque motor head sensor, and metering valve.

The engine driven fuel pump is mounted on the rear face of the accessory gearbox and provides a mount for the fuel control. The fuel pump incorporates a boost pump and high pressure pump, filter element and filter bypass valve, and high pressure relief valve.

(Codes A, C) An anti-ice valve is contained in the fuel pump to control fuel flow through the fuel heater of the oil system.

The filter bypass valve on the fuel pump allows bypass of fuel around the fuel filter when the pressure drop across the filter is excessive. An integral delta pressure indicator of the valve visually flags an excessive differential pressure condition before bypassing occurs by extending a pin from the valve.

R (Pre SB73-3028) The fuel flow divider of the flow divider and drain valve directs primary and secondary fuel flows to the fuel nozzles. Initially fuel flows through the primary section of the flow divider. As combustion occurs and the fuel flow requirements increases, the flow divider directs fuel flow through the secondary as well as primary section to maintain proper fuel flow. The drain valve of the flow divider and drain valve is capped in accordance with current Environmental Protection Agency regulations.

R (Post SB73-3028) The flow divider valve directs primary and secondary fuel flows to the fuel nozzles. Initially, fuel flows through the primary section of the flow divider. As combustion occurs and the flow requirement increases, the flow divider directs fuel flow through the secondary as well as the primary section to maintain proper fuel flow.

FUEL SYSTEM INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Materials and Compounds

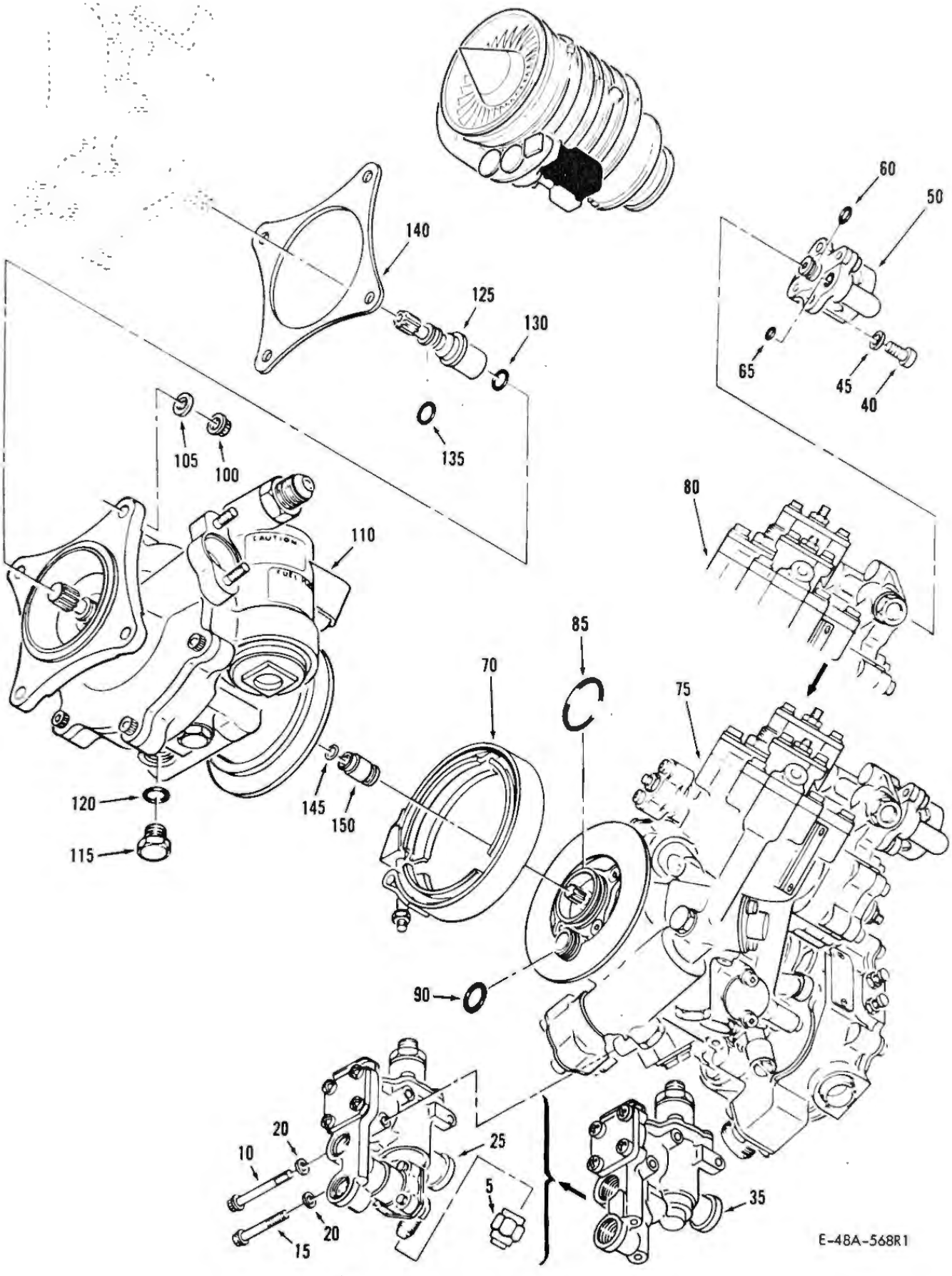
Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Grease (Krytox 240AC)	DuPont E.I. De Nemours and Co, Inc, 1007 Market St, Wilmington, DE 19898
Degreaser and cleaner (MS-180 Freon TF)	Miller-Stephensen Chemical Co, Inc, P.O. Box 628, 16 Sugar Hollow Rd, Danbury, CT 06810

CAUTION: FUEL CONTROL FORWARD SHAFT, FOR COUPLING TO FUEL PUMP, AND FUEL CONTROL AFT SHAFT, FOR COUPLING TO AIRCRAFT POWER LEVER LINKAGE, MAY BE DAMAGED IF PROPER HANDLING IS NOT OBSERVED. PROVIDE SUITABLE PROTECTION FOR SHAFTS. DO NOT REST UNIT ON SHAFTS. DO NOT ALLOW ANY FORCE AGAINST SHAFTS WHICH MAY BEND SHAFTS, DAMAGE SPLINES, OR DAMAGE INTERNAL FUEL CONTROL PARTS.

A. Remove Fuel Control (See Figure 201)

NOTE: Before removing fuel control for failed electrical resistance check, verify resistance measurements at fuel control connectors in accordance with 73-21-01, 3, Inspection/Check.

(1) Remove fuel and P3 pneumatic tubes, fittings, and packings from fuel control and flow divider and drain valve (or flow divider valve) in accordance with 73-10-02 and 79-20-07, MAINTENANCE PRACTICES.



R

Fuel System Installation
Figure 201

1. A. (2) Disconnect electrical connectors from fuel control.

(3) Support aft end of fuel control and loosen clamp coupling to separate fuel control from fuel pump. Remove clamp coupling and packings.

(4) Remove screws and washers securing flow divider and drain valve (or flow divider valve) to fuel control. Remove valve.

(5) (Post SB73-3011 or SB73-3012) Remove screws and washers securing pressure (P3) limiter valve and remove P3 limiter valve. Remove packings from pressure limiter valve. If P3 limiter valve is not to be immediately reinstalled, install 3070917-1 shipping cover with packings over valve cavity in fuel control and secure with screws and washers.

R (6) (Post SB73-3009, Pre SB73-3028) Remove cap from flow
R divider and drain valve.

KEY TO FIGURE 201

R 5.	CAP (POST SB73-3009, PRE SB73-3028) (IPC FIG. 25)	75.	FUEL CONTROL (PRE SB73-3011)
R 10.	SCREW	80.	FUEL CONTROL (POST SB73-3011)
R 15.	SCREW	85.	PACKING
R 20.	WASHER	90.	PACKING
R 25.	FLOW DIVIDER AND DRAIN VALVE (PRE SB73-3028)	100.	NUT
R 35.	FLOW DIVIDER VALVE (POST SB73-3028)	105.	WASHER
R 40.	SCREW	110.	FUEL PUMP
R 45.	WASHER	115.	PLUG
R 50.	PRESSURE (P3) LIMITER VALVE (POST SB73-3011)	120.	PACKING
R 60.	PACKING (POST SB73-3011)	125.	SPLINED SHAFT
R 65.	PACKING (POST SB73-3011)	130.	PACKING
R 70.	CLAMP COUPLING	135.	PACKING
		140.	GASKET
		145.	RETAINING RING
		150.	SHAFT COUPLING

1. B. Remove Fuel Pump (See Figure 201)

(1) Remove fuel control in accordance with paragraph 1.A.

(2) (Codes A, C) Remove fuel lines from fuel pump in accordance with 79-20-06, MAINTENANCE PRACTICES.

(3) Support aft end of fuel pump, then remove four nuts and washers securing fuel pump to gearbox. Remove fuel pump and gasket.

(4) Remove splined shaft with packings.

(5) Remove shaft coupling and retaining ring.

(6) Remove plug and packing.

NOTE: Refer to 73-21-02, MAINTENANCE PRACTICES for maintenance of fuel pump.

C. Install Fuel Pump (See Figure 201)

CAUTION: ENSURE CORRECT PART NUMBER OF FUEL PUMP IS USED. USE OF INCORRECT FUEL PUMP MAY DAMAGE FUEL CONTROL. IF ENGINE IS OPERATED WITH INCORRECT FUEL PUMP INSTALLED, FUEL CONTROL SHALL ALSO BE REPLACED.

(1) Ensure gearbox spline cavity, splined shaft, and fuel pump forward splines are thoroughly clean. Remove any grease from these areas using degreaser and cleaner (MS-180 Freon TF).

(2) Install packing on plug and install plug.

(3) Insert shaft coupling in fuel pump and secure with retaining ring. Ensure coupling does not extend past surface of fuel pump which mates with fuel control. Position gasket on fuel pump mounting flange.

(4) Install packings in exterior and interior grooves of splined shaft. Pack internal spline cavity of shaft and internal spline cavity of gearbox drive gear which mates with shaft with grease (Krytox 240AC), then install shaft on fuel pump shaft.

(5) Position fuel pump on gearbox studs with splined shaft engaged on gearbox drive gear splines, then secure with washers and nuts.

(6) (Codes A, C) Install fuel lines on fuel pump in accordance with 79-20-06, MAINTENANCE PRACTICES.

1. C. (7) Install fuel control on fuel pump in accordance with paragraph 1.D.

(8) Ensure fuel filter bypass valve indicator pin is not extended. Press pin into valve body if required.

D. Install Fuel Control (See Figure 201)

CAUTION: OVERBOARD DRAIN GOVERNOR PORT (72-00-00, FIGURE 104) MUST BE UNOBSTRUCTED AND VENTED TO ATMOSPHERE FOR PROPER FUEL CONTROL OPERATION.

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Position flow divider and drain valve (or flow divider valve) on fuel control, then secure with screws and washers.

(2) (Post SB73-3011) If installed, remove 3070917-1 shipping cover with packings and attaching screws and washers to allow installation of limiter valve. Install pressure (P3) limiter valve with packings, then secure with screws and washers. Tighten screws (40) to torque of 15 to 20 inch-pounds.

R R (3) (Post SB73-3009, Pre SB73-3028) Install cap on flow divider and drain valve.

CAUTION: THE SHAFT COUPLING SHALL BE ON THE FUEL PUMP SHAFT PRIOR TO INSTALLING FUEL CONTROL ON FUEL PUMP. WITHOUT SHAFT COUPLING, THE MECHANICAL N2 GOVERNOR IS NOT DRIVEN AND ENGINE WILL OVERSPEED RAPIDLY IN MANUAL MODE.

NOTE: Clamp coupling shall be positioned with latching bolt inboard and with nut down.

(4) Install new packings at forward face of fuel control. Support fuel control on fuel pump with shaft engaging shaft coupling in fuel pump and secure with clamp coupling. Tighten nut on clamp coupling (70, figure 201) to torque of 35 to 45 inch-pounds. Tap clamp coupling around complete outer diameter, then re-check torque on nut of clamp coupling. Repeat as required until torque is unchanged when re-checked.

1. D. (5) Attach fuel and P3 pneumatic tubes to fuel control and flow divider and drain valve (or flow divider valve) in accordance with 73-10-02, and 79-20-07, MAINTENANCE PRACTICES.

(6) (Code A) Install electrical connectors P6 and P7 on fuel control, using TG65-1 through TG65-7 strap wrenches (Glenair Inc, 1211 Air Way, Glendale, CA 91201). Tighten connectors as follows: P6 - 46 to 50 inch-pounds torque: P7 - 70 to 75 inch-pounds torque.

(7) (Codes B, C) Install and tighten electrical connectors on fuel control in accordance with Aircraft Maintenance Manual.

(8) Purge fuel system of air in accordance with 72-00-00, GENERAL - SERVICING, steps 1.A.(2) through 1.A.(8).

2. Inspection/Check

A. Inspect Fuel System Installation Components

(1) Inspect assemblies for obvious damage such as ruptured housings and fuel leaks.

(2) Replace assemblies if ruptured housings are evident. Replace packings illustrated on Figure 201 as required to stop fuel leaks.

(3) Inspect shaft coupling for damage.

(4) Inspect splined shaft for damaged splines.

(5) Inspect coupling clamp for obvious damage and condition of threads.

(6) Refer to 73-21-01, MAINTENANCE PRACTICES for inspection of fuel control. Refer to 73-21-02, MAINTENANCE PRACTICES for inspection of fuel pump.

3. Adjustment/Test

A. Perform Procedures Required When Replacement Fuel Control is Installed

Comply with 72-00-00, GENERAL - ADJUSTMENT/TEST, paragraphs 8 and 9 after installation of a replacement fuel control.

B. Perform Procedures Requried When Replacement Fuel Pump is Installed

R Comply with 72-00-00, GENERAL - ADJUSTMENT/TEST, paragraph 11 after installation of a replacement fuel pump.

4. Cleaning/Painting

Table 202. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Degreaser and cleaner (MS-180 Freon TF)	Miller-Stephensen Chemical Co, Inc, P.O. Box 628, 16 Sugar Hollow Rd, Danbury, CT 06810

A. Clean Parts

Clean grease (Krytox 240AC) from components using degreaser and cleaner (MS-180 Freon TF). Clean parts as specified in Table 203 in accordance with cleaning methods provided in 72-00-00, GENERAL - CLEANING/PAINTING.

Table 203. Cleaning Methods

	Figure No.	Item No.	Nomenclature	Cleaning Methods 1	2	3	4	5	6	7	8	9	10	11	12
	All standard metallic hardware			X	X										
	201	5	Cap	X	X							X			
		70	Clamp	X	X							X			
R		115	Plug	X	X							X			
R		125	Splined Shaft	X	X							X			
R		145	Ring Retainer	X	X							X			
R		150	Coupling Shaft	X	X							X			

R

FUEL CONTROL COMPONENTS- MAINTENANCE PRACTICES

1. Removal/Installation

CAUTION: FUEL CONTROL FORWARD SHAFT, FOR COUPLING TO FUEL PUMP, AND FUEL CONTROL AFT SHAFT, FOR COUPLING TO AIRCRAFT POWER LEVER LINKAGE, MAY BE DAMAGED IF PROPER HANDLING IS NOT OBSERVED. PROVIDE SUITABLE PROTECTION FOR SHAFTS. DO NOT REST UNIT ON SHAFTS. DO NOT ALLOW ANY FORCE AGAINST SHAFTS WHICH MAY BEND SHAFTS, DAMAGE SPLINES, OR DAMAGE INTERNAL FUEL CONTROL PARTS.

A. Remove Fuel Control Fuel Filter (See Figure 201 or 203)

(1) Remove fuel control in accordance with 73-20-01, MAINTENANCE PRACTICES.

(2) Loosen screw securing fuel filter retainer under flange of bearing retainer assembly.

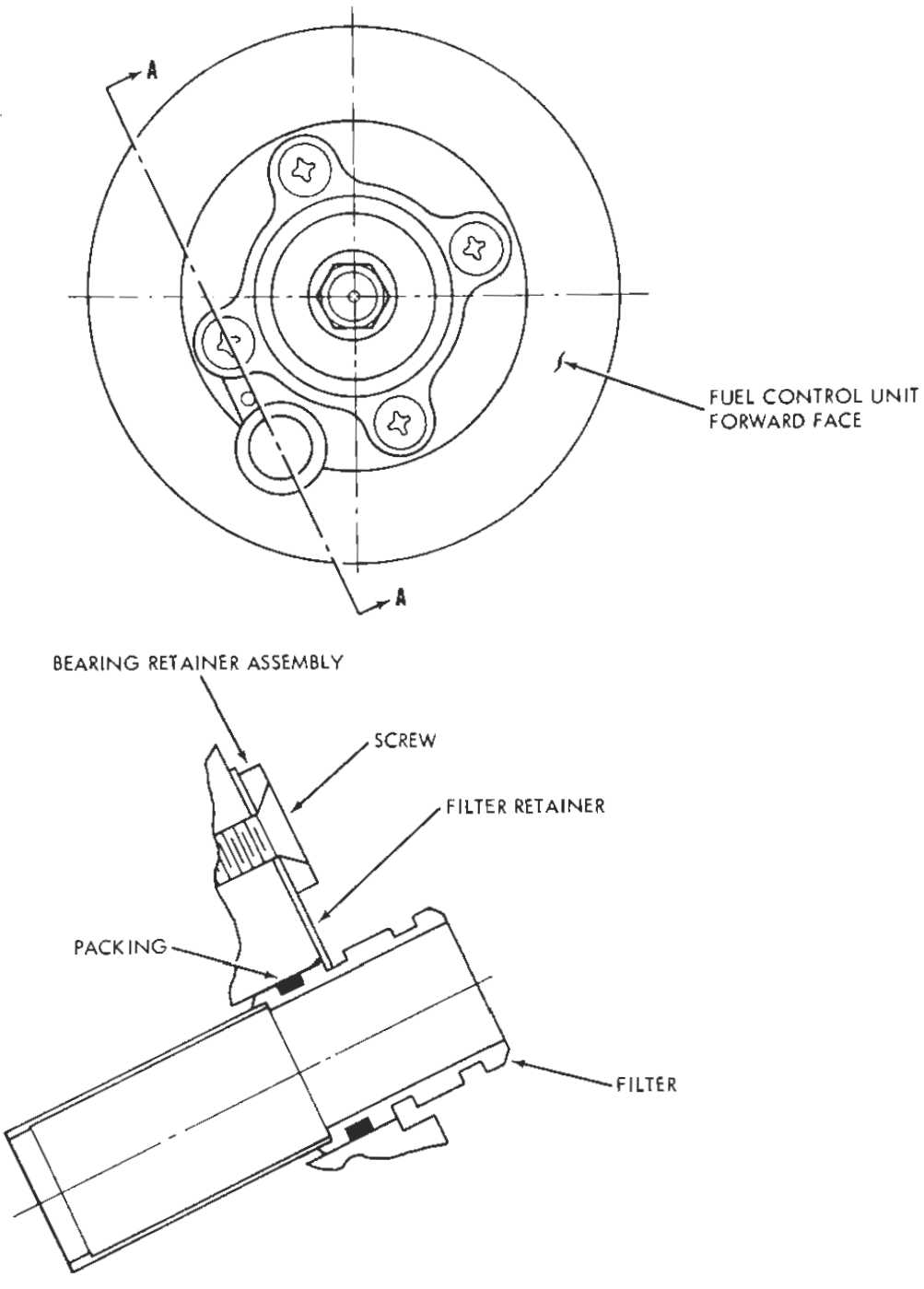
(3) Move fuel filter retainer back to disengage groove in filter.

(4) Remove fuel filter and assembled packing from fuel control. Remove packing from filter.

B. Install Fuel Control Fuel Filter (See Figure 201 or 203)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Install new packing on fuel filter.



Fuel Control Fuel Filter
Figure 201

CAUTION: ENSURE FUEL FILTER IS INSERTED TO THE LEVEL REQUIRED TO ALIGN GROOVE FOR RETAINER. FUEL FILTER WILL BE DAMAGED IF INSERTED TOO FAR IN FUEL CONTROL AND WILL CAUSE FUEL LEAK.

1. B. (2) Insert fuel filter with assembled packing in filter bore on forward face of fuel control unit. Insert filter to depth required to align retainer on fuel control with retainer groove on filter.

(3) Move fuel filter retainer to engage groove in filter, then tighten screw to secure end of filter retainer under bearing retainer assembly flange. Tighten screw to torque of 30 to 40 inch-pounds. Check to ensure retainer is engaged in proper groove of filter.

(4) Install fuel control in accordance with 73-20-01, MAINTENANCE PRACTICES.

2. Adjustment/Test

A. Adjust Manual Governor Cam Adjustment

Comply with 72-00-00, GENERAL - ADJUSTMENT/TEST, paragraphs 8 and 9 after installation of a replacement fuel control.

3. Inspection/Check

A. Inspect Fuel Control

(1) Inspect control for leakage, security and damage.

R (2) Inspect electrical connectors for broken or damaged pins.

NOTE: Do not attempt field repair of fuel control except as specified in 5, Approved Repairs.

(3) Inspect threaded inserts on power lever cover of fuel control (see figure 202 or 203) for security or damage. If damage is evident, refer to 5, Approved Repairs.

(4) Replace fuel control if leakage is evident or if damage exceeds scope of 5, Approved Repairs.

B. Perform Fuel Control Electrical Resistance Checks

(1) Check resistance of each pin of fuel control electrical connectors J6 and J7 to fuel control case. Resistance shall be more than 10 megohms for each pin.

CAUTION: ENSURE OHMMETER CURRENT DOES NOT EXCEED 10 MA WHEN MEASURING POWER LEVER POTENTIOMETER RESISTANCES IN THE FOLLOWING STEPS.

3. B. (2) Check power lever potentiometer wiper resistance from J6-3 to J6-4 with power lever shaft angle at 120 degrees. Resistance shall be 4.5K to 22K ohms. Reduce power lever shaft angle to 26 degrees; resistance shall be less than 1000 ohms. Reduce power lever shaft angle to zero degrees; resistance shall be less than 12K ohms. Replace power lever potentiometer in accordance with 5, Approved Repairs if requirement is not met.

(3) (Post SB73-3018) Check power lever potentiometer tap resistance from J6-4 to J6-6. Resistance shall be 5K to 10K ohms. Replace power lever potentiometer in accordance with 5, Approved Repairs if requirement is not met.

(4) Check total power lever potentiometer resistance from J6-4 to J6-5. Resistance shall be 4.5K to 22K ohms and shall not change with power lever shaft rotation. Replace power lever potentiometer in accordance with 5, Approved Repairs if requirement is not met.

(5) Check manual mode solenoid resistance from J6-7 to J6-8. Resistance shall be 40 to 50 ohms.

(6) Check resistance of overspeed solenoid from J6-1 to J6-2. Resistance shall be 40 to 50 ohms.

(7) Check resistance of torque motor coils from J7-A to J7-B, and from J7-C to J7-D. Resistance shall be 160 to 230 ohms and shall be the same +10 ohms.

(8) Replace fuel control if requirements are not met and repair is beyond scope of 5, Approved Repairs.

C. Inspect Fuel Control Fuel Filter

Inspect fuel filter for erosion damage, tears, deformation, and cleanliness. Clean dirty filter. Replace damaged filter.

4. Cleaning/Painting

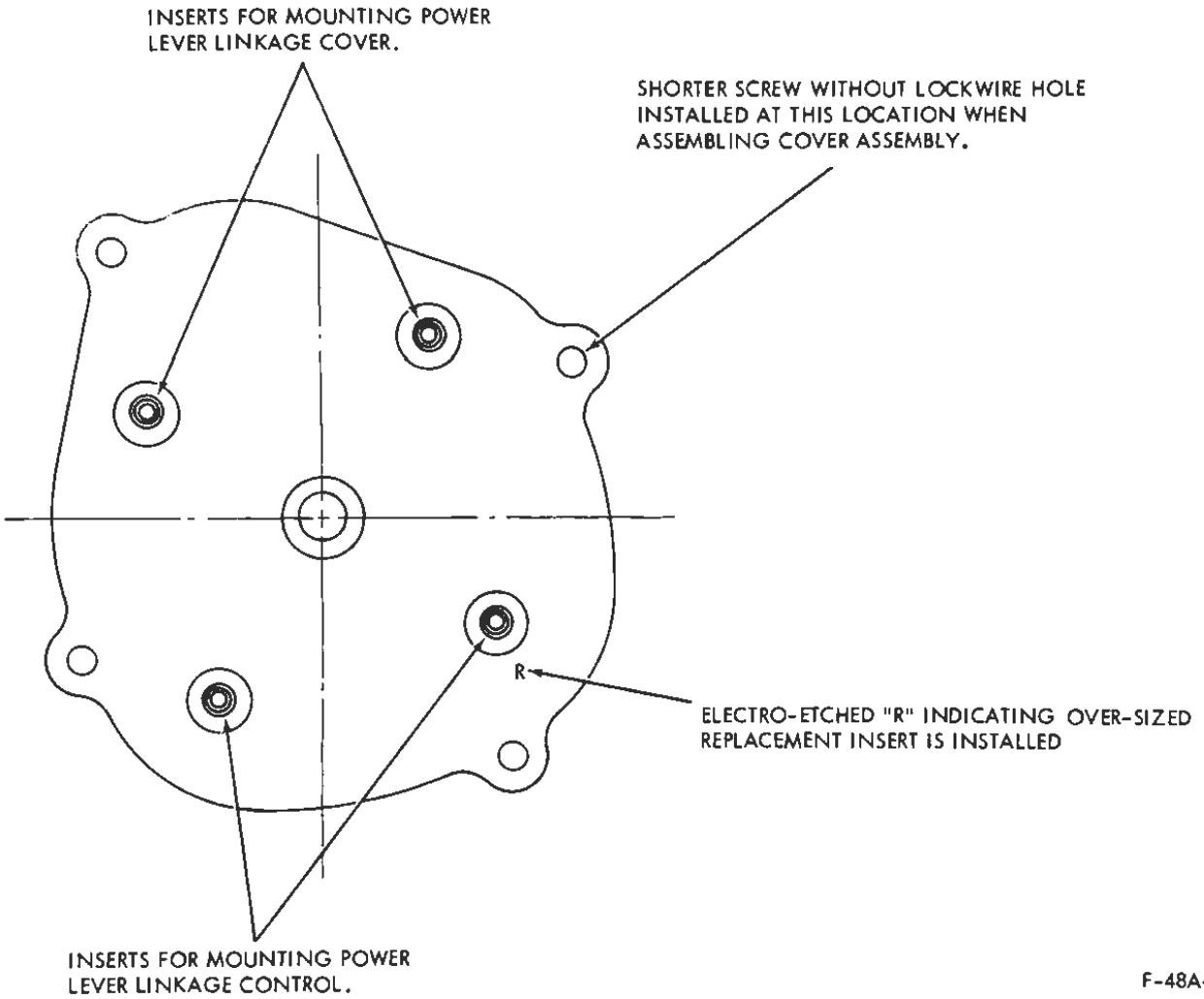
A. Clean Parts

Clean fuel control fuel filter in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method No. 1.

5. Approved Repairs

Table 201. Equipment and Materials

Equipment or Materials	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
R Insulation sleeving R (S9124-16-012) R	The Garrett Corporation, AiResearch Manufacturing Company of Arizona, P. O. Box 29003, Phoenix, AZ 85038
R Insulation sleeving R (S9124-10-104) R	The Garrett Corporation, AiResearch Manufacturing Company of Arizona, P.O. Box 29003, Phoenix, AZ 85038
Pin extractor (AT2020LS)	Astro Tool Co, Inc, 3941 W 139th St, Hawthorne, CA 90250
Pin inserter (ATB1067)	Astro Tool Co, Inc, 3941 W 139th St, Hawthorne, CA 90250
R Primer (P-415-66-611B R and C1178-66 Catalyst) R	Griggs Paint, Subsidiary of Domcom Dist, 3602 S 16th Place, Phoenix, AZ 85040
Solder (Sn60, Federal Specification QQ-S-571)	Commercially available
Solvent, Stoddard (Federal Specification P-D-680, Type I)	Commercially available


INSERTS FOR MOUNTING POWER LEVER LINKAGE COVER.
SHORTER SCREW WITHOUT LOCKWIRE HOLE INSTALLED AT THIS LOCATION WHEN ASSEMBLING COVER ASSEMBLY.
R
ELECTRO-ETCHED "R" INDICATING OVER-SIZED REPLACEMENT INSERT IS INSTALLED
INSERTS FOR MOUNTING POWER LEVER LINKAGE CONTROL.
F-48A-162

Insert Replacement in Power Lever Cover
Figure 202

5. A. Replace Damaged Inserts in Power Lever Cover (See Figure 202 or 203)

NOTE: Inserts with the letter "R" electro-etched adjacent to the insert boss have been previously replaced and may not be repaired in accordance with the following procedure.

(1) Remove four screws and washers securing Power Lever Cover Part No. 3070726-1 over power lever shaft, then remove cover. Provide protective covering over fuel control until cover is reinstalled.

(2) Use No. 8 (0.199 inch diameter) drill to drill into damaged insert to a depth of 3/32 inch.

(3) Bend exposed locking "kees" on insert inward and break off.

(4) Remove damaged insert using easy-out type tool.

(5) Drill through boss for replacement insert using 0.272 inch diameter drill.

(6) Countersink drilled hole at 82 to 100 degrees to a diameter of 0.323 (+0.010/-0.000) inch.

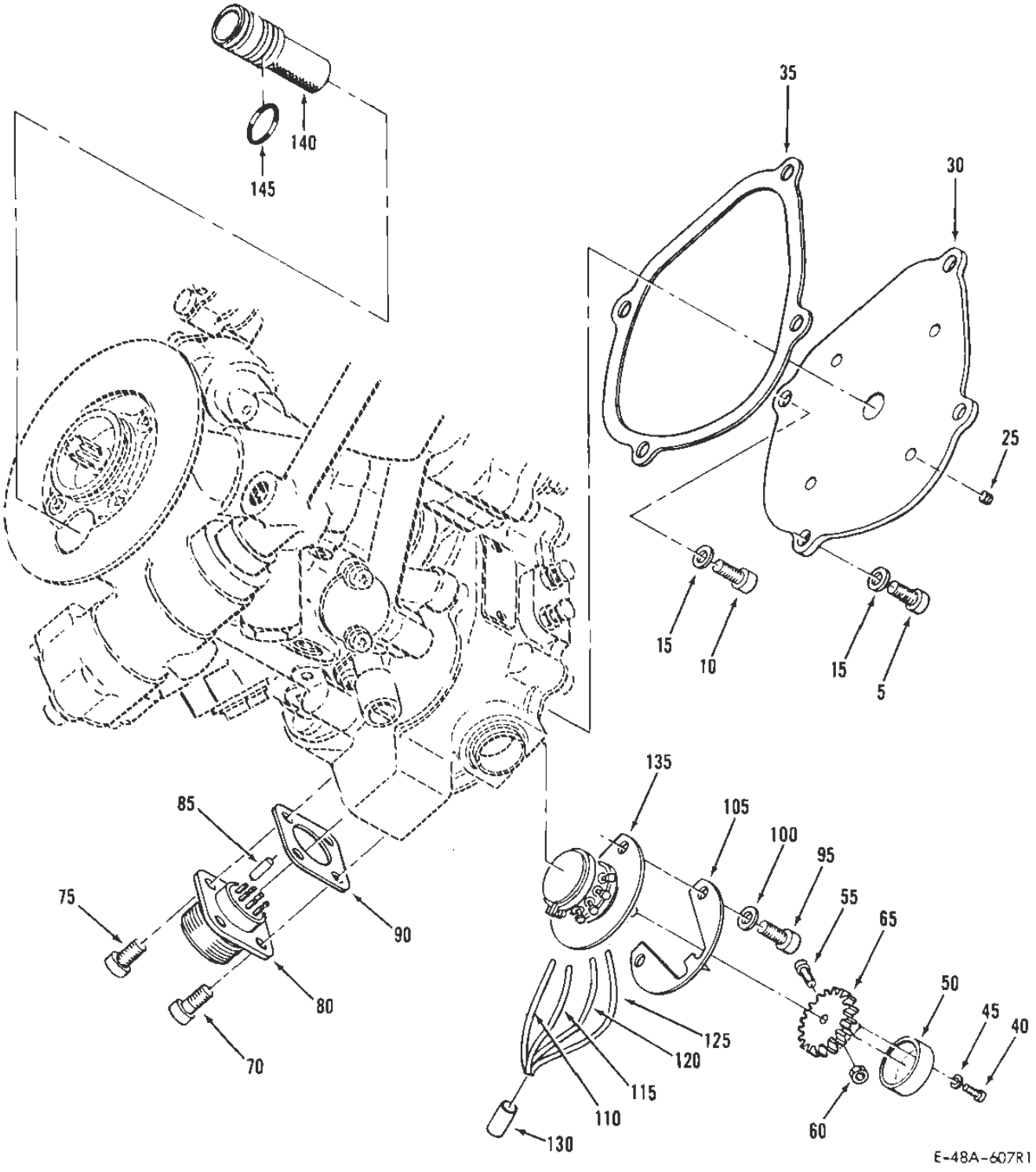
(7) Tap drilled boss with UNC-2B-5/16-18 threads to a minimum depth of 0.37 inch. Clean hole with solvent, Stoddard (Federal Specification P-D-680, Type I).

R (8) Mix primer (P-415-66-611B and C1178-66 Catalyst) in
R equal parts by volume and allow to stand for 30
R minutes. Apply a thin wet coat to cover all internal surfaces of prepared hole.

(9) While primer is still wet, thread replacement Insert (Keensert) Part No. KNHBL0832J (Tridair Industries, Fastener Div, 3000 W Lomita Blvd, Torrance, CA 90505) into prepared hole until body of insert is 0.010 - 0.020 inch below top surface of boss. Insert may not protrude through inside surface of cover assembly more than 0.115 inch. Drive in locking "kees" on insert until flush with insert body.

(10) Touch up area immediately adjacent to installed insert
R by wiping with primer (P-415-66-611B and C1178-66
R Catalyst) to seal surface scratches.

R



Fuel Control Exploded View for Power
Lever Potentiometer Replacement
Figure 203

5. A. (11) Electro-etch the letter "R" adjacent to the boss for the replacement insert as shown on Figure 202 to indicate over-sized repair insert has been installed.

(12) Allow primer to cure for four to six hours at room temperature or for one hour in oven at 82 to 135C (180 to 275F).

(13) Install power lever cover with screws and washers removed in step (1). Install shorter screw with no lockwire hole at location shown on Figure 202.

B. Replace Defective Variable Resistor (Power Lever Potentiometer)

(1) Remove power lever potentiometer. (See figure 203.)

(a) Remove screws and washers securing power lever cover, then remove cover and gasket.

(b) Remove screw and washer securing indicator dial, then remove indicator dial.

(c) Remove nut and screw securing spur gear, then remove spur gear.

KEY TO FIGURE 203

R 5.	SCREW (IPC FIG. 26)	85.	INSULATION SLEEVING
R 10.	SCREW	90.	GASKET
R 15.	WASHER	95.	SCREW
R 25.	INSERT	100.	WASHER
R 30.	COVER	105.	POSITION INDICATOR
R 35.	GASKET	110.	WIRE
R 40.	SCREW	115.	WIRE
R 45.	WASHER	120.	WIRE
R 50.	INDICATOR DIAL	125.	WIRE (POST SB73-3018)
R 55.	SCREW	130.	INSULATION SLEEVING
R 60.	NUT	135.	VARIABLE RESISTOR (POWER LEVER POTENTIOMETER)
R 65.	SPUR GEAR		
R 70.	SCREW		
R 75.	SCREW	140.	FUEL FILTER (INLET SCREEN)
R 80.	ELECTRICAL		
R	CONNECTOR J6	145.	PACKING

5. B. (1) (d) Note orientation of key of electrical connector J6 to fuel control housing. Remove screws securing electrical connector J6 and pull electrical connector out from fuel control for access to connector pins.

(e) (Pre SB73-3018) On connector J6 with soldered pin connections, unsolder wires from pins J6-3, J6-4, J6-5. On connector J6 with crimped pin connections, push pins J6-3, J6-4, and J6-5 out of connector using pin extractor (AT2020LS).

(f) (Post SB73-3018) On connector J6 with soldered pin connections, unsolder wires from pins J6-3, J6-4, J6-5, and J6-6. On connector J6 with crimped pin connections, push pins J6-3, J6-4, J6-5, and J6-6 out of connector using pin extractor (AT2020LS).

(g) Remove screws and washers securing position indicator and variable resistor (power lever potentiometer). Remove position indicator.

(h) Remove power lever potentiometer with attached wires and insulation sleeving.

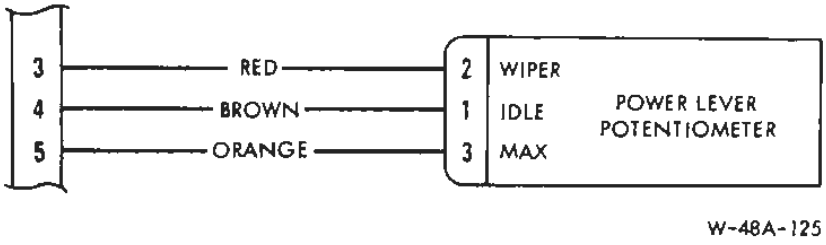
(i) Unsolder wires from power lever potentiometer terminals and remove wires with insulation sleeving.

(2) Install replacement power lever potentiometer. (See figure 203.)

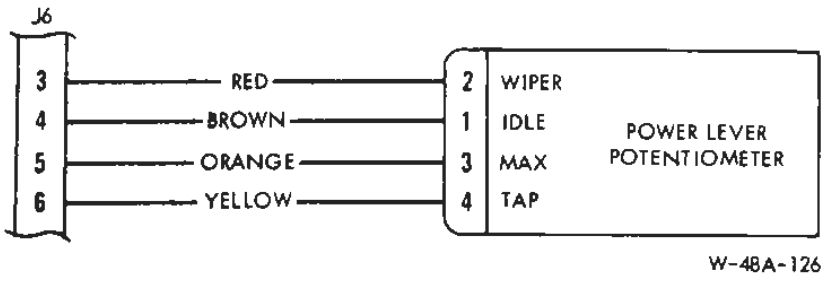
(a) Prior to installing power lever potentiometer on fuel control, perform the following resistance checks. Replace power lever potentiometer if resistance is not as specified.

CAUTION: ENSURE OHMMETER CURRENT DOES NOT EXCEED 10 MA WHEN PERFORMING THE FOLLOWING CHECKS. POTENTIOMETER WILL BE DAMAGED BY CURRENT EXCEEDING 10 MA.

Potentiometer Terminals	Required Resistance (ohms)
1 to 3	4.5K to 22.0K
(Post SB73-3018)1 to 4	5K to 10K
(Post SB73-3018) 3 to 4	5K to 15K



(Pre SB73-3018) Power Lever Potentiometer
Electrical Connections
Figure 204



(Post SB73-3018) Power Lever Potentiometer
Electrical Connections
Figure 205

5. B. (2) (b) Solder wires to potentiometer terminals (figure 204 or 205, as applicable), using solder (Sn60, Federal Specification QQ-S-571).

(c) Install power lever potentiometer into fuel control, routing attached wires through insulation sleeving (S9124-10-104) for connection to electrical connector J6. Install position indicator and secure components with washers and screws. Ensure no wires are pinched between potentiometer case and fuel control housing.

(d) Position heat shrink sleeving (S9124-16-012) over end of each wire to be connected to electrical connector J6, when connector J6 with soldered pin connections is used.

(e) On connector J6 with soldered pin connections, solder wires to electrical connector pins (figure 204 or 205, as applicable).

(f) On connector J6 with crimped pin connections, insert pins at applicable connector pin locations (figure 204 or 205, as applicable), using pin inserter (ATB1067).

(g) On connector J6 with soldered pin connections, push insulation sleeving over connector terminals and shrink insulation sleeving using a heat gun.

(h) Secure electrical connector J6 and associated gasket to fuel control with screws, ensuring key of connector is oriented to fuel control as noted at disassembly.

(i) Remove screw for rig pin hole (figure 206).

(j) Rotate power lever shaft at aft end of fuel control to align rig pin slot with rig pin hole (figure 206). Install a three-inch long, 0.125-inch diameter rig pin through rig pin hole and into slot in gear.

(k) Install spur gear on power lever potentiometer shaft, then secure with screw and nut.

5. B. (2) (1) Install indicator dial on spur gear. Locate indicator dial on spur gear so 20-degree reading is aligned with position indicator pointer while maintaining light counterclockwise pressure on power lever shaft to remove any slack. With indicator dial aligned, secure indicator dial with screw and washer. Remove rig pin.

(m) Check setting of maximum and minimum stops at full counterclockwise and full clockwise rotation of power lever shaft. If stops do not occur at 120 to 122 degrees and at 0 to -2 degrees, slightly readjust pointer or indicator dial to meet requirement. Do not adjust setting of maximum or minimum stops.

(3) Check and calibrate power lever potentiometer.

CAUTION: ENSURE POWER SUPPLY OUTPUT CURRENT DOES NOT EXCEED 10 MA WHEN PERFORMING THE FOLLOWING CHECKS. POTENTIOMETER WILL BE DAMAGED BY CURRENT EXCEEDING 10 MA.

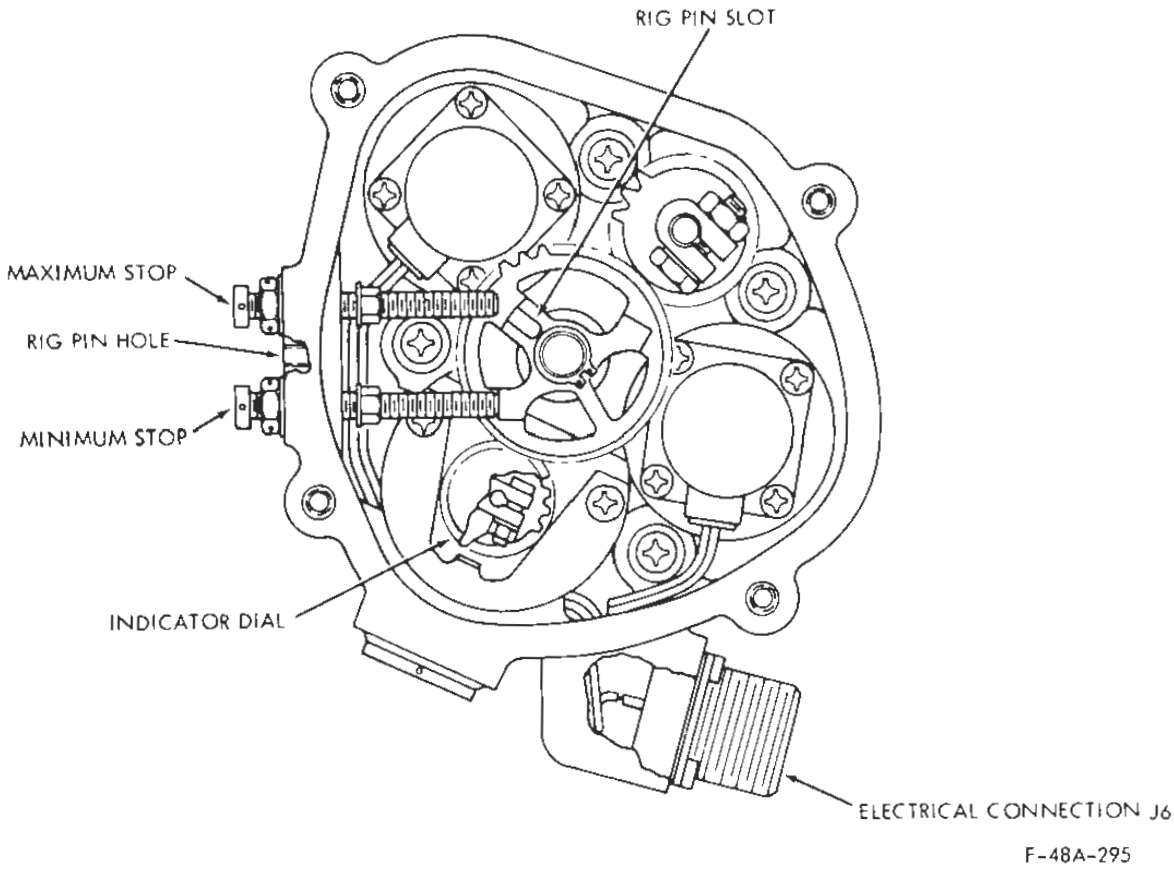
(a) Connect variable voltage source across J6-5 (+) and J6-4 (-) and adjust voltage to 10.0 volts dc.

(b) (Pre SB73-3018) Set power lever shaft at aft end of fuel control to 68.00 $\pm$0.50 degrees as indicated on fuel control indicator dial.

(c) (Pre SB73-3018) Measure voltage across J6-3 (+) and J6-4 (-). Voltage shall be 6.90 $\pm$0.05 volts dc. If voltage is not as specified, calibrate shaft position of potentiometer as follows.

1) Maintain setting of power lever shaft and spur gear, and remove screw and washer securing indicator dial. Remove indicator dial.

2) Loosen nut securing spur gear to potentiometer shaft enough to allow shaft rotation within spur gear.



Fuel Control Component Identification
Figure 206

5. B. (3) (c) 3) Rotate potentiometer shaft to obtain specified voltage indication wihtout changing position of spur gear and power lever shaft.

4) Tighten nut to secure spur gear to potentiometer shaft.

5) Reinstall indicator dial in accordance with steps (2)(j),(l), and (m).

6) Repeat applicable voltage check to ensure voltage requirement is now met.

(d) (Post SB73-3018) Set power lever shaft at aft end of fuel control to 40.0 ±0.5 degrees as indicated on fuel control indicator dial.

(e) (Post SB73-3018) Measure voltage across J6-6 (+) and J6-4 (-) and note value. Measure voltage across J6-3 (+) and J6-4 (-) and note value. Noted values shall be the same within 0.01 volt dc. If difference voltage is not as specified, calibrate shaft position of potentiometer in accordance with steps (3)(c)1) through 6).

(f) Set power lever shaft to 118.0 ±0.5 degrees as indicated on indicator dial.

(g) Measure voltage across J6-3 (+) and J6-4 (-) and note value. Measure voltage across J6-5 (+) and J6-4 (-) and note value. Noted values shall be the same within 0.03 volt dc. If difference voltage is not as specified, reposition potentiometer shaft (steps (3)(c)1) through 6)) to meet requirements of both (3)(c) or (e) (as applicable) and this step. Replace power lever potentiometer if requirements cannot be met.

(h) Set power lever shaft to 20.0 ±0.5 degrees as indicated on indicator dial.

(i) Measure voltage across J6-3 (+) and J6-4 (-). Voltage shall be less than 0.05 volt dc. If voltage is not as specified, reposition potentiometer shaft (steps (3)(c)1) through 6)) to meet requirements of (3)(c) or (e) (as applicable), step (3)(g), and (3)(i). Replace power lever potentiometer if requirements are not met.

5. B. (4) Finish assembly of fuel control. (See figure 203.)

(a) Install gasket for cover, then install cover on aft face of fuel control. Secure cover with screws and washers.

(b) Install screw in rig pin hole (figure 206).

R FUEL PUMP COMPONENTS - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Lubricating compound (Liqui-Moly, Grade NV, Thread Compound)	Lockrey Co, Lubricants Div, Cedar Shores, Southampton, NY 11968

NOTE: The following Maintenance Practices do not require the removal of the fuel pump.

A. Remove Fuel Filter Element (See Figure 201)

(1) Using wrench on square fitting of filter bowl cover, unscrew and remove filter bowl cover. Remove packing from filter bowl cover.

(2) Remove fuel filter element from filter cavity of fuel pump. Remove packing from fuel filter element.

B. Remove Motive Flow Plug (See Figure 201)

R (1) (Code B) Remove motive flow plug. Remove packing from motive flow plug.

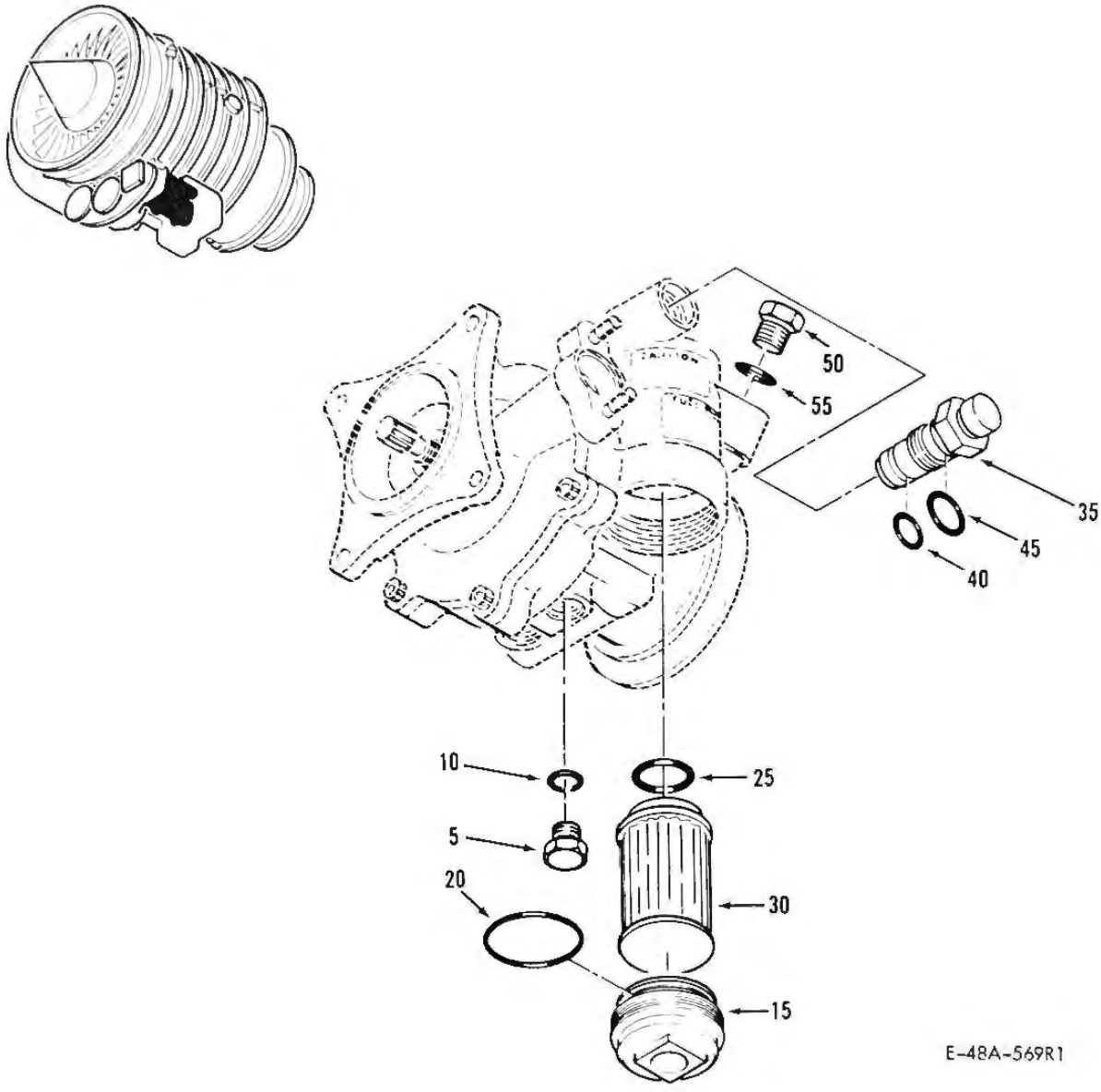
R (2) (Post SB73-3027) Remove plug. Remove packing from
R plug.

C. Remove Filter Bypass Indicator (See Figure 201)

(1) Unscrew and remove filter bypass indicator.

(2) Remove packings from filter bypass indicator.

R



R Fuel Pump (Field Maintenance Breakdown)
Figure 201

1. D. Install Filter Bypass Indicator (See Figure 201)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Install packings on filter bypass indicator.

(2) Screw filter bypass valve fully into pump. Tighten filter bypass indicator (35) to 30 to 40 inch-pounds torque.

E. Install Plugs (See Figure 201)

R (1) (Code B) Install new packing on motive flow plug, then install motive flow plug.

R (2) (Post SB73-3027) Install new packing on plug, then in-
R stall plug.

F. Install Fuel Filter Element (See Figure 201)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Install new packings on fuel filter element and filter bowl cover.

(2) Install fuel filter element in filter cavity of fuel pump.

(3) Coat threads of filter bowl cover with light coat of lubricating compound (Liqui-Moly, Grade NV, thread compound). Install filter bowl cover (15) and tighten to torque value of 40 inch-pounds.

KEY TO FIGURE 201

5. PLUG (MOTIVE FLOW)
R (CODE B) (IPC FIG. 25A)
10. PACKING (CODE B)
15. FILTER BOWL COVER
R 20. PACKING
R 25. PACKING
30. FUEL FILTER ELEMENT
35. FILTER BYPASS INDICATOR
40. PACKING
45. PACKING
50. PLUG (POST SB73-3027)
55. PACKING (POST SB73-3027)

2. Inspection/Check

A. Inspect Fuel Pump

(1) Inspect fuel pump for security, leakage, or physical damage.

(2) Inspect filter bowl cover for stripped or damaged threads, or any obvious damage.

(3) Inspect fuel filter element for damage and cleanliness. Refer to 3, Cleaning/Painting.

(4) Inspect fuel filter bypass indicator for obvious damage and condition of threads.

R (5) Inspect threads of plugs and bosses for obvious damage.

R (6) Replace items that do not meet inspection requirements of steps (1) through (5).

3. Cleaning/Painting

Table 202. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Blackstone ultrasonic cleaner (SP-103)	J.E. Phillips Co, Inc, P.O. Box 192, 10608 Culver Blvd, Culver City, CA 90230
Cleaner (Dowclene)	Dow Corning Corp, S Saginaw Rd, Midland, MI 48640
Degreaser and cleaner (MS-180 Freon TF)	Miller-Stephensen Chemical Co, Inc, P.O. Box 628, 16 Sugar Hollow Rd, Danbury, CT 06810
Electrocleaner (Wyandotte FS)	Wyandotte Chemicals Corp, Wyandotte, MI 48192
Muriatic acid (35 Percent HCL, Commercial Grade)	Commercially available

Table 202. Materials and Compounds (Cont)

Material or Compound	Manufacturer
Rust stripper (Oakite Rust Stripper)	Oakite Products Inc, 50 Valley Rd, Berkeley Heights, NJ 07922
Solvent (Shell 360)	Shell Oil Co, 50 W 50th St, New York, NY 10020
Solvent, Stoddard (Federal Specification P-D-680, Type I)	Commercially available

WARNING: CLEANING SHALL BE PERFORMED IN A CLEAN, WELL-VENTILATED ROOM. RUBBER GLOVES AND PROTECTIVE CLOTHING SHALL BE WORN. EXTINGUISHERS AND VAT OR TANK COVERS SHALL BE ON HAND IN CASE OF FIRE.

NOTE: Filter element of fuel pump may be cleaned by dipping in solvent (Shell 360) and dried with filtered compressed air. However, the sonic cleaning method should be employed for a thorough cleaning. If sonic cleaning equipment is not available, use alternate method described below.

3. A. Clean Filter Element by Sonic Method

NOTE: Beaker is used to conserve cleaner (Dowclene). Use tap water as transmitting fluid in sonic cleaner (SP-103).

(1) Place filter element in beaker of cleaner (Dowclene). Orient filter element so open end is up. Level of cleaner in beaker shall be below open end of filter. Place beaker in sonic cleaner.

(2) Operate sonic cleaner with filter element for five (5) minutes. Cleaner will become dirty.

(3) Discard dirty cleaner and rinse filter element and beaker with new cleaner using plastic squeeze bottle.

(4) Refill beaker with new cleaner and operate sonic cleaner for five (5) additional minutes.

3. A. (5) Repeat steps (3) and (4) until cleaner remains clean after a five (5) minute operation period.

(6) Remove filter element and blow dry using clean air supply.

(7) Although there may be no apparent damage to packing installed in neck of filter element, replace packing after completion of sonic cleaning.

B. Clean Fuel Filter Element Using Alternate Method

(1) Remove packing and thoroughly degrease fuel filter element in cold solvent, Stoddard (Federal Specification P-D-680, Type I).

(2) Prepare a solution of rust stripper (Oakite Rust Stripper) by combining three to five pounds of rust stripper to each gallon of water. Maintain prepared solution at 72 to 82C (162 to 180F). Employ air agitation to keep solution in suspension.

(3) Soak fuel filter element in rust stripper (Oakite Rust Stripper) solution for 30 minutes.

(4) Remove fuel filter element from solution and rinse thoroughly with clean water.

(5) Prepare solution of electrocleaner (Wyandotte FS) by combining nine ounces of electrocleaner to each gallon of water. Maintain solution at 22 to 34C (72 to 93F). Immerse fuel filter element in electrocleaner solution for four to six minutes. During this period fuel filter element shall be made an anode for one to two minutes at a potential of four to seven volts dc. Rinse fuel filter element in cold running tap-water.

(6) Immerse fuel filter element in equal parts muriatic acid (35 percent HCL) and water, by volume, at room temperature for one-half to one minute. Rinse fuel filter element thoroughly in cold running tap water.

3. B. (7) Immerse fuel filter element in electrocleaner solution prepared in step (5) maintained at temperature of 22 to 34C (72 to 93F) for four to six minutes. Rinse in cold running tap water.

(8) Rinse fuel filter element in clean hot water. Dry fuel filter element with filtered compressed air. If cleaned fuel filter element is not to be installed immediately, place in clean container.

C. Clean Parts

Clean grease (Krytox 240AC) from components using degreaser and cleaner (MS-180 Freon TF). Clean parts as specified in Table 203 in accordance with cleaning methods provided in 72-00-00, GENERAL - CLEANING/PAINTING.

Table 203. Cleaning Methods

Figure No.	Item No.	Nomenclature	Cleaning Methods 1	2	3	4	5	6	7	8	9	10	11	12
All standard metallic hardware			X	X										
201	5	Plug	X	X							X			
	15	Cover	X	X										
	30	Fuel Filter	Refer to paragraph 3.A. or 3.B.											
R	50	Plug	X	X							X			

LIST OF EFFECTIVE PAGES
72-00-72

CHAPTER/ SECTION	PAGE	DATE	CHAPTER/ SECTION	PAGE	DATE
List of Effective Pages	-	Apr 30/80			
Record of Temporary Revisions	-	Jun 29/79			
Table of Contents	-	Jun 29/79			
74-00-00	1	Jun 29/79			
	2	Blank			
74-00-01	201	Nov 15/79			
	202	Jun 29/79			
	203	Jun 29/79			
	204	Apr 30/80			
	205	Apr 30/80			
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	219	Jun 29/79			
	220	Jun 29/79			
	221	Jun 29/79			
	222	Nov 15/79			

RECORD OF TEMPORARY REVISIONS

REV NO.	CHAP/SEC/ SUBJ PAGE NO.	DATE ISSUED	DATE INSERTED	BY	DATE REMOVED	BY	INCORPO-RATED INTO MANUAL BY REV NO.

CHAPTER 74 - IGNITION

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GENERAL - DESCRIPTION AND OPERATION

1. Ignition System

The ignition system operates on 24 volts dc (nominal) power. It consists of an ignition unit, igniter leads, and igniter plugs.

2. Ignition Unit

The ignition unit, mounted on the upper left side of the fan bypass housing, is a radio noise suppressed, high voltage, capacitor discharge, periodic sparking type unit. The ignition unit utilizes 10 to 30 volts dc input (40 volts dc for short periods) to provide separate and independent secondary outputs of 18,000 to 24,000 volts to the igniter plugs. The system is capable of continuous operation when required and selected by manually operated switch. The unit provides voltage to produce sparks at the approximate rate of two per second to each igniter lead.

3. Igniter Leads

The igniter leads are shielded, high-tension flexible leads connecting the ignition unit and igniter plugs.

4. Igniter Plugs

The igniter plugs are mounted at six and seven o'clock on the turbine plenum. The plugs are operated by separate igniter leads and fire when pulsed by the ignition unit.

IGNITION UNIT AND IGNITER PLUGS INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
High temperature compound (Fel-Pro C-5A)	Fel-Pro Inc, Div of Felt Products Mfg Co, 7450 N McCormick Blvd, Skokie, IL 60076

A. Remove Ignition Unit and Igniter Plugs (See Figure 201)

(1) Shut off electrical supply to engine.

(2) Remove bottom panel in accordance with 79-20-09, MAINTENANCE PRACTICES.

(3) Remove service tube clamps in accordance with 73-10-03, MAINTENANCE PRACTICES.

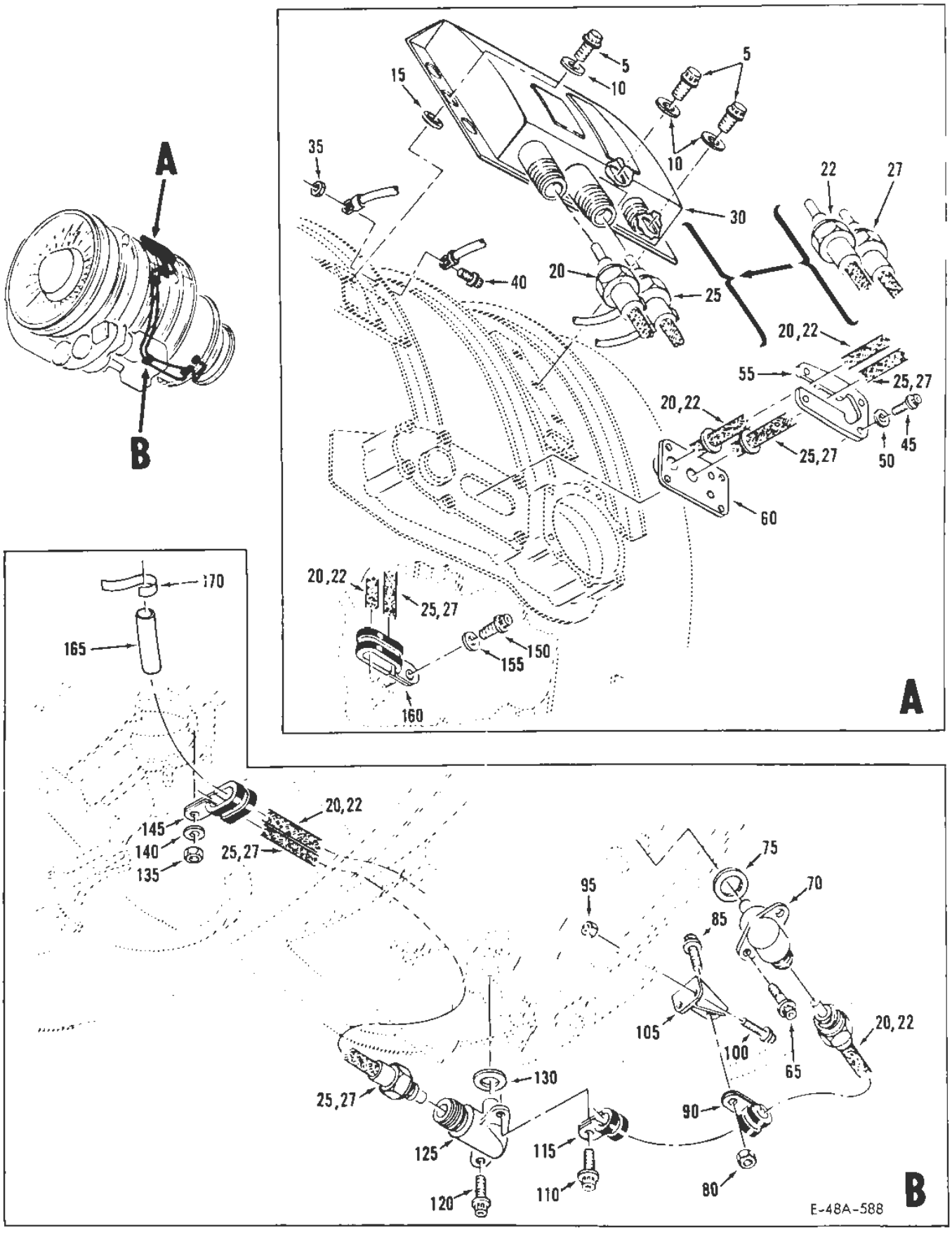
(4) Disconnect wiring harness electrical connector from ignition unit in accordance with Aircraft Maintenance Manual.

CAUTION: BENDING IGNITER LEADS WHEN DISCONNECTING FROM IGNITION UNIT WILL CAUSE DAMAGE TO INTERNAL INSULATION OF IGNITER LEADS. TO AVOID BENDING IGNITER LEADS, REMOVE IGNITION UNIT MOUNTING BOLTS BEFORE DISCONNECTING IGNITER LEADS FROM IGNITION UNIT.

(5) Remove ignition unit mounting bolts and washers and disconnect igniter lead connectors from ignition unit and igniter plugs. Remove ignition unit.

R R (6) When igniter leads with restraining cables are used, remove nut and bolt securing restraining cables to fan duct set.

(7) Remove bolts which secure igniter plugs to engine. Remove igniter plugs and gaskets.



Ignition Unit, Igniter Plugs, and Igniter Leads
Figure 201

1. A. (8) Remove bolts, nuts, clamps, and bracket securing igniter lead at bottom of combustion chamber plenum case.

(9) Remove bolts and washers which secure lock plate and grommet to engine. Remove lock plate and grommet.

NOTE: (Pre SB72-3040) The igniter leads cannot be disassembled with engine installed on aircraft except for igniter lead tip replacement or replacement of internal conductor. Replace igniter lead tips if damage is indicated at inspection. Replace igniter lead internal conductor if failure is indicated at 2, Adjustment/Test.

(10) If igniter leads are to be removed from engine, check for presence of insulation sleeving on igniter leads just forward of clamp securing igniter leads at bottom of low pressure compressor case assembly. If no insulation is installed, mark point on leads 0.50 to 0.75 inch forward of clamp to locate position for insulation sleeving to be installed after removal of igniter leads.

KEY TO FIGURE 201

5.	BOLT (IPC FIG. 30)	85.	BOLT
10.	WASHER	90.	CLAMP
15.	WASHER	95.	NUT
20.	IGNITER LEAD (IPC FIG. 31)	100.	BOLT
22.	IGNITER LEAD	105.	MOUNTING BRACKET
25.	IGNITER LEAD	110.	BOLT
27.	IGNITER LEAD	115.	CLAMP
30.	IGNITION UNIT (IPC FIG. 30)	120.	BOLT
35.	NUT	125.	IGNITION PLUG
40.	BOLT	130.	GASKET
45.	BOLT	135.	NUT
50.	WASHER	140.	WASHER
55.	LOCK PLATE	145.	CLAMP
60.	GROMMET	150.	BOLT
65.	BOLT (IPC FIG. 31)	155.	WASHER
70.	IGNITER PLUG	160.	CLAMP
75.	GASKET	165.	SLEEVING
80.	NUT	170.	TAPE

1. A. (11) (Post SB72-3040) Remove igniter leads from engine as follows.

(a) (Code A) Remove engine wiring harness. Refer to 72-00-02, MAINTENANCE PRACTICES.

(b) Remove tube assemblies from solenoid controller valve in accordance with 76-10-01, MAINTENANCE PRACTICES.

R (c) (Code C) (Codes A, B Pre SB72-3085) Remove pneumatic tube to anti-ice pressure switch and pneumatic tube to solenoid controller valve in accordance with 75-10-01, MAINTENANCE PRACTICES.

(d) Remove upper section of fan duct set in accordance with 72-70-05, MAINTENANCE PRACTICES.

(e) Remove left and right side panels in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 203.)

(f) Remove upper air/oil cooler in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 204 or 205.)

(g) Remove bolts, washers, and clamps securing igniter lead, then remove igniter leads. Do not remove insulation sleeving or tape from igniter leads unless damaged. If insulation sleeving and tape must be removed, mark location on lead before removal for aid when installing new tape and sleeving.

(12) (Pre SB72-3040) Remove igniter leads from engine (engine removed from aircraft) as follows.

(a) (Code A) Remove engine wiring harness in accordance with 72-00-02, MAINTENANCE PRACTICES.

(b) Remove fuel heater or oil to cooler tube installation in accordance with 79-20-06, MAINTENANCE PRACTICES.

(c) Remove fuel/oil cooler installation in accordance with 79-20-07, MAINTENANCE PRACTICES.

(d) Remove tubes from oil tank to oil pump and accessory drive gearbox in accordance with 79-10-01, MAINTENANCE PRACTICES.

(e) Remove fuel and P3 sensing lines installation in accordance with 73-10-02, MAINTENANCE PRACTICES.

1. A. (12) (f) Remove fuel system installation in accordance with 73-20-01, MAINTENANCE PRACTICES.

(g) Remove oil pump and chip detector installation in accordance with 79-20-03, MAINTENANCE PRACTICES.

(h) Remove accessory and transfer gearbox installation in accordance with 72-60-01, MAINTENANCE PRACTICES.

R (i) (Code C) (Codes A, B Pre SB72-3085) Remove pneumatic tube to anti-ice pressure switch and pneumatic tube to solenoid controller valve in accordance with 75-10-01, MAINTENANCE PRACTICES.

(j) Remove solenoid controller valve with attached pneumatic tubes in accordance with 76-10-01, MAINTENANCE PRACTICES.

(k) Remove right side duct, oil-out tube, left side fairing and oil-in tube in accordance with 79-20-09, MAINTENANCE PRACTICES.

(l) Remove bottom duct rib and oil transfer tubes in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 202.)

(m) Remove screws, bolts, washers, and nuts securing fan duct assembly to engine support housing in accordance with 72-70-05, MAINTENANCE PRACTICES.

(n) Remove bleed air ducts in accordance with 75-10-05, MAINTENANCE PRACTICES, then remove fan duct assembly.

(o) Remove left and right side panels in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 203.)

(p) Remove upper air/oil cooler in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 204 or 205, as applicable.)

(q) Remove bolts, washers, and clamps securing igniter leads, then remove igniter leads. Do not remove insulation sleeving or tape from igniter leads unless damaged. If insulation sleeving and tape must be removed, mark location on lead before removal for aid when installing new tape and sleeving.

1. B. Install Ignition System Components (See Figure 201)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

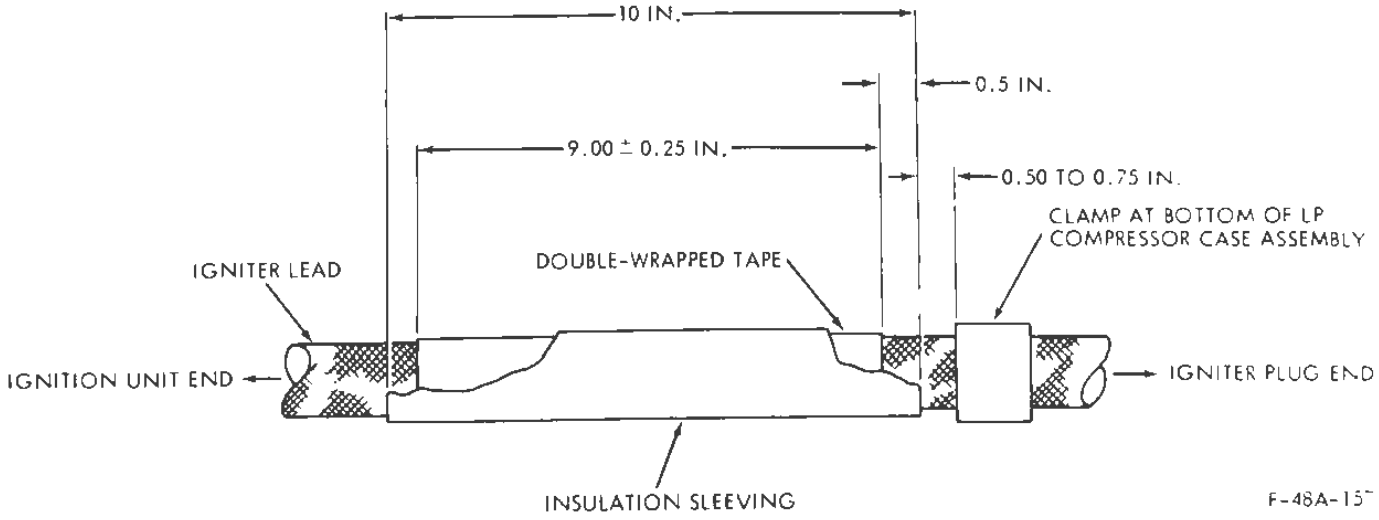
(1) Install tape and insulation sleeving on igniter leads (removed from engine) if not previously installed or if removed because of damage. (See figure 202.)

(a) Locate points marked on igniter leads for positioning insulation sleeving.

(b) Double wrap each lead with tape (170, figure 201). Tape wrap shall extend nine inches and be positioned so ends of tape will not be exposed after installation of insulation sleeving. (See figure 202.)

(c) Install ten inch length of insulation sleeving (165, figure 201) on each lead, enclosing tape and extending from mark made at removal toward ignition unit end of lead. (See figure 202.)

(d) Shrink insulation sleeving in place using hot air.



Tape and Insulating Sleeving
Figure 202

1. B. (2) (Codes A, B, Pre SB72-3040) Install igniter leads on engine (engine removed from aircraft).

(a) Position igniter leads on engine and secure with clamp, washer, and bolt on low pressure compressor case assembly. Tighten bolt (150, figure 201) to torque of 50 inch-pounds.

(b) Install upper air/oil cooler in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 204 or 205, as applicable.)

(c) Install left and right side panels in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 203.)

(d) Position fan duct assembly on engine. Install bleed air ducts in accordance with 75-10-05, MAINTENANCE PRACTICES.

(e) Secure fan duct assembly to engine support housing in accordance with 72-70-05, MAINTENANCE PRACTICES.

(f) Install bottom duct rib and oil transfer tubes in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 202.)

(g) Install right side duct, oil-out tube, left side fairing, and oil-in tube in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 201.)

(h) Install solenoid controller valve and attached pneumatic tubes in accordance with 76-10-01, MAINTENANCE PRACTICES.

R (i) (Code C) (Codes A, B Pre SB72-3085) Install pneumatic tube to anti-ice pressure switch and pneumatic tube to solenoid controller valve in accordance with 75-10-01, MAINTENANCE PRACTICES.

(j) Install accessory and transfer gearbox installation in accordance with 72-60-01, MAINTENANCE PRACTICES. At installation of tower shaft housing, secure igniter leads with clamp under nut and washer on stud used to secure tower shaft housing. Tighten nut (20, figure 201) to torque of 50 inch-pounds.

(k) Install oil pump and chip detector installation in accordance with 79-20-03, MAINTENANCE PRACTICES.

1. B. (2) (l) Install fuel system installation in accordance with 73-20-01, MAINTENANCE PRACTICES.

(m) Install fuel and P3 sensing lines installation in accordance with 73-10-02, MAINTENANCE PRACTICES.

(n) Install tubes from oil tank to oil pump and accessory drive gearbox in accordance with 79-20-03, MAINTENANCE PRACTICES.

(o) Install fuel/oil cooler installation in accordance with 79-20-07, MAINTENANCE PRACTICES.

(p) Install fuel heater or oil to cooler tube installation in accordance with 79-20-06, MAINTENANCE PRACTICES.

(q) (Code A) Install engine wiring harness in accordance with 72-00-02, MAINTENANCE PRACTICES.

(3) (Post SB72-3040) Install igniter leads on engine.

NOTE: When igniter leads without restraining cables are being replaced with igniter leads with restraining cables, tape restraining cables back against igniter leads.

(a) Position igniter leads on engine and secure with clamp, washer, and bolt to low pressure compressor case assembly. Tighten bolt (150, figure 201) to torque of 50 inch-pounds. Secure igniter leads at stud for mounting tower shaft housing with clamp, washer, and nut. Tighten nut (135, figure 201) to torque of 50 inch-pounds.

(b) Install upper air/oil cooler in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 204 or 205.)

(c) Install left and right side panels in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 203.)

(d) Install upper section of fan duct set in accordance with 72-70-05, MAINTENANCE PRACTICES.

R (e) (Code C) (Codes A, B Pre SB72-3085) Install pneumatic tube to anti-ice pressure switch and pneumatic tube to solenoid controller valve in accordance with 75-10-01, MAINTENANCE PRACTICES.

1. B. (3) (f) Install tube assemblies on solenoid controller valve in accordance with 76-10-02, MAINTENANCE PRACTICES.

(g) (Code A) Install engine wiring harness in accordance with 72-00-02, MAITENANCE PRACTICES.

NOTE: It is important that igniter lead elbows located directly below ignition unit be positioned properly to prevent chafing against air/oil coolers and fan duct set.

(4) Install grommet and lock plate on igniter leads leaving lock plate loose. Position igniter lead elbows to fit.

(5) Secure lock plate to engine with bolts and washers. Tighten bolts (45, figure 201) to torque of 15 inch-pounds.

CAUTION: BOLTS SECURING IGNITER PLUGS SHALL BE TIGHTENED ALTERNATELY IN TEN INCH-POUND INCREMENTS UNTIL FINAL TORQUE OF 50 INCH-POUNDS IS OBTAINED TD PULL IGNITER PLUG IN PLACE EVENLY WITHOUT COCKING. A GAP MAY EXIST UNDER IGNITER PLUG FLANGE AFTER TIGHTENING BOLTS. DO NOT TIGHTEN BOLTS TO TORQUE OF MORE THAN 50 INCH-POUNDS AS IGNITER PLUG MOUNTING FLANGES MAY BE CRACKED.

(6) Install one new gasket on each igniter plug. Install clamp on longer igniter lead at position for bolt (110, figure 201). Coat threads of bolts to secure igniter plugs with high temperature compound (Fel-Pro C5-A). Secure igniter plugs to engine with attaching bolts. Alternately tighten bolts (65, 110, 120, figure 201) in ten inch-pound increments to torque of 50 inch-pounds, then lockwire bolts.

(7) Install igniter leads on igniter plugs. Tighten connectors of igniter leads (20, 25, or 22, 27, figure 201) at igniter plugs to torque of 150 inch-pounds.

(8) Install mounting bracket with nuts and bolts. Tighten bolts (100, figure 201) to torque of 80 inch-pounds.

R (9) When igniter leads with restraining cables are used,
R secure terminals on restraining cables to fan duct set with nut and bolt.

CAUTION: BENDING IGNITER LEADS WHEN CONNECTING TO IGNITION UNIT WILL CAUSE DAMAGE TO INTERNAL INSULATION OF IGNITER LEADS. DO NOT MOUNT IGNITION UNIT ON ENGINE BEFORE CONNECTING IGNITER LEADS TO IGNITION UNIT.

1. B. (10) Install igniter leads on ignition unit. Tighten connector of igniter leads finger tight.

(11) Position ignition unit on engine. If necessary for ignition unit to clear fan duct set, install washers (maximum of one at each mounting boss) between mounting bosses and ignition unit.

(12) Install washers and ignition unit mount bolts (5, figure 201) and tighten to torque of 50 inch-pounds.

(13) Secure longer igniter lead to mounting bracket with clamp using attaching nut, bolt, and washer. Tighten bolt (85, figure 201) to torque of 50 inch-pounds.

(14) Tighten igniter leads at ignition unit to torque of 150 inch-pounds.

(15) Install service tube clamps in accordance with 73-10-03, MAINTENANCE PRACTICES.

(16) Install bottom panel in accordance with 79-20-09.

(17) Connect wiring harness electrical connector to ignition unit in accordance with Aircraft Maintenance Manual.

2. Adjustment/Test

NOTE: Inspect all components, prior to testing, in accordance with 3, Inspection/Check.

A. Perform Ignition System Test

WARNING: ELECTRICAL DISCHARGE AT IGNITER PLUGS IS DANGEROUS. DO NOT COME IN CONTACT WITH IGNITER PLUG SPARK GAP WHEN IGNITER PLUGS ARE CONNECTED TO IGNITION UNIT. AT CONCLUSION OF CHECK, REMOVE STATIC CHARGE FROM IGNITER PLUGS BY SHORTING ACROSS SPARK GAP. USE SHIELDED JUMPER WIRE OR WELL INSULATED TOOL WHEN SHORTING SPARK GAP. CONDUCT TEST IN AREA FREE OF FLAMMABLE FLUIDS OR VAPORS. WHENEVER OBSERVING IGNITER PLUG FIRING, WEAR SUITABLE EYE PROTECTION TO PROTECT FROM HIGH INTENSITY LIGHT.

NOTE: The following is a bench check of the complete ignition system. Components of system (ignition unit, igniter plugs, and igniter leads) of known serviceability may be used with a component suspected of being defective to determine if serviceable, or serviceability of complete system may be verified.

2. A. (1) Connect igniter plugs to igniter leads and connect igniter leads to ignition unit.

(2) Connect variable dc power source (0 to 30 volts) across ignition unit electrical connector J3 pins A (-) and B (+).

(3) Turn on variable dc power source and adjust for 28 to 30 volts dc. Each igniter plug shall fire at a rate not exceeding 360 sparks per minute for a minimum of 30 seconds. If requirements are not met, proceed to step (5). If requirements are met, proceed to step (4).

(4) Reduce output of variable dc power source to 10 volts dc. Each igniter plug shall fire at a rate of at least 60 sparks per minute for a minimum of 30 seconds. If requirements are met, ignition system is serviceable. Shut off power supply and terminate test. If requirements are not met proceed to step (5).

(5) If requirements of step (3) or (4) are not met, isolate defective component or components as described in Table 203 or 204, as applicable.

TABLE 203. IGNITION SYSTEM TEST (BOTH IGNITER PLUGS FAIL TEST) TROUBLE SHOOTING PROCEDURES

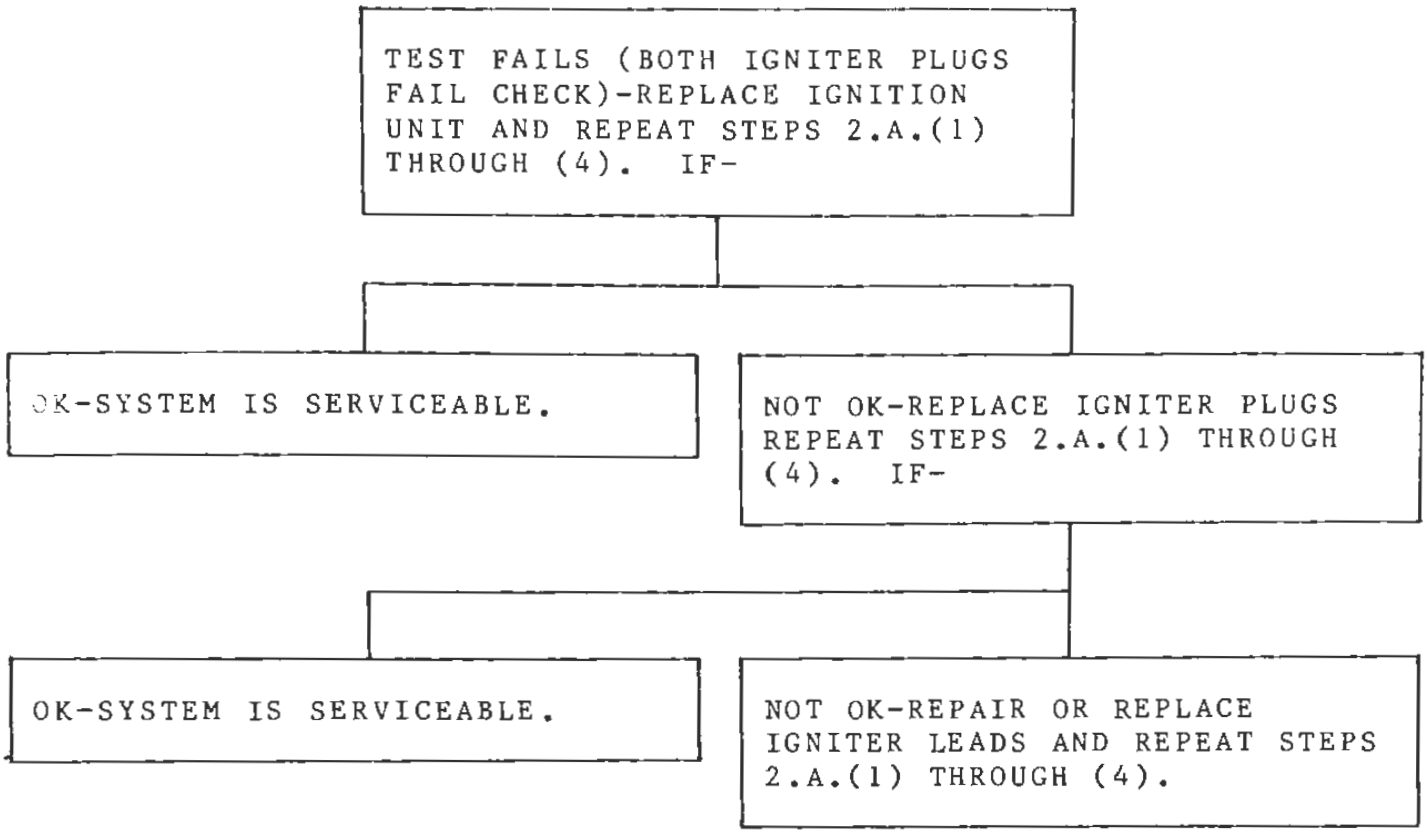
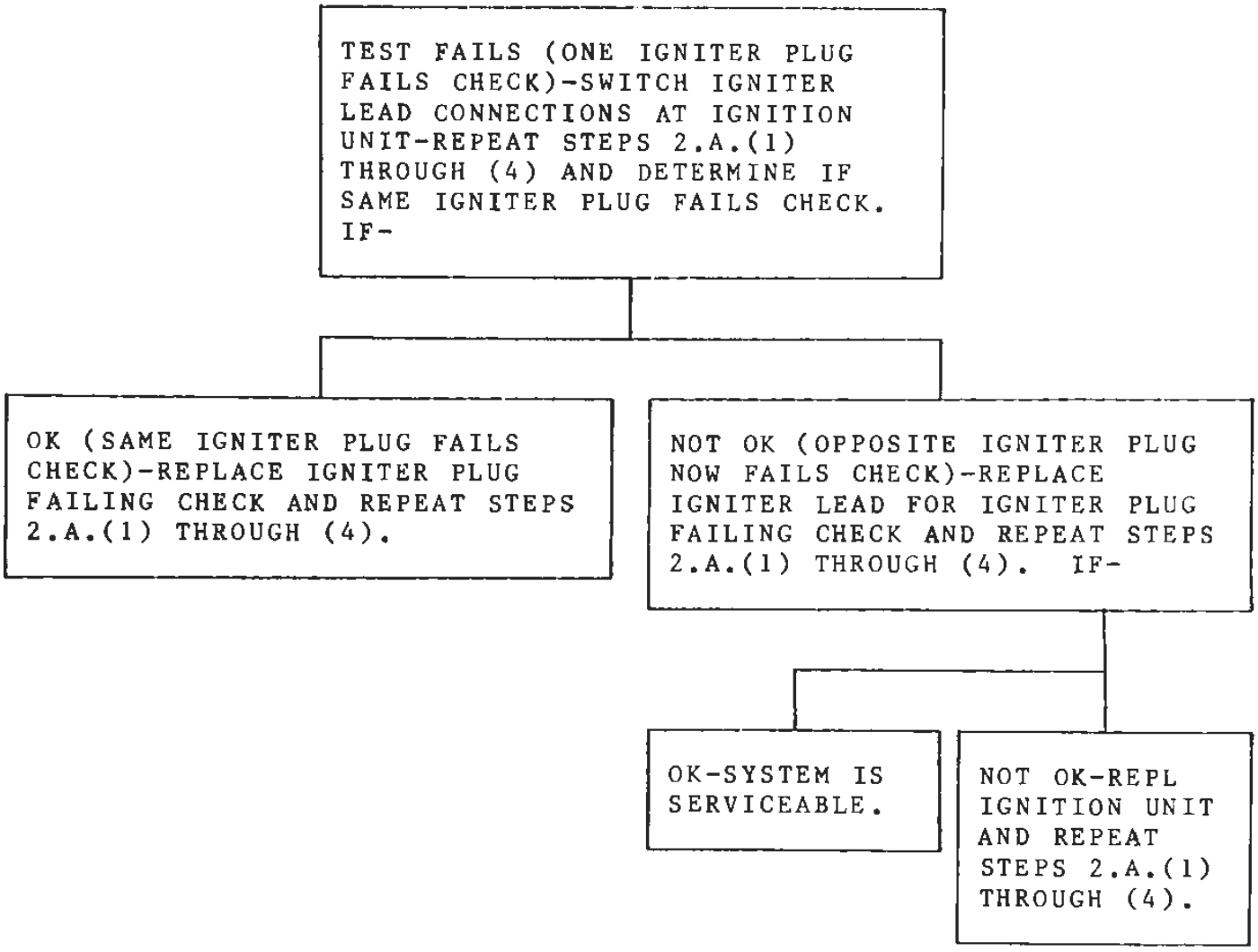

TEST FAILS (BOTH IGNITER PLUGS FAIL CHECK)-REPLACE IGNITION UNIT AND REPEAT STEPS 2.A.(1) THROUGH (4). IF-
OK-SYSTEM IS SERVICEABLE.
NOT OK-REPLACE IGNITER PLUGS REPEAT STEPS 2.A.(1) THROUGH (4). IF-
OK-SYSTEM IS SERVICEABLE.
NOT OK-REPAIR OR REPLACE IGNITER LEADS AND REPEAT STEPS 2.A.(1) THROUGH (4).

TABLE 204. IGNITION SYSTEM TEST (ONE IGNITER PLUG FAILS TEST) TROUBLE SHOOTING PROCEDURE


TEST FAILS (ONE IGNITER PLUG FAILS CHECK)-SWITCH IGNITER LEAD CONNECTIONS AT IGNITION UNIT-REPEAT STEPS 2.A.(1) THROUGH (4) AND DETERMINE IF SAME IGNITER PLUG FAILS CHECK. IF-
OK (SAME IGNITER PLUG FAILS CHECK)-REPLACE IGNITER PLUG FAILING CHECK AND REPEAT STEPS 2.A.(1) THROUGH (4).
NOT OK (OPPOSITE IGNITER PLUG NOW FAILS CHECK)-REPLACE IGNITER LEAD FOR IGNITER PLUG FAILING CHECK AND REPEAT STEPS 2.A.(1) THROUGH (4). IF-
OK-SYSTEM IS SERVICEABLE.
NOT OK-REPL IGNITION UNIT AND REPEAT STEPS 2.A.(1) THROUGH (4).

3. Inspection/Check

A. Inspect Ignition Unit

(1) Inspect unit for nicks, cracks, excessive wear, burns, corrosion, punctures, and damaged or bent connector pins.

(2) Inspect threaded surfaces for worn, crossed, or peened threads. Ensure threaded parts turn freely on mating parts.

(3) Replace unit if inspection requirements are not met.

B. Inspect Igniter Leads

(1) Visually inspect igniter leads for frayed shielding, burned wire insulation or braided covering, and condition of terminals and silicone grommets. No damage is allowed.

NOTE: Overheating of igniter lead terminals may be caused by hot gas leakage, either around igniter plug gasket or through igniter plug insulator. If evidence of overheating or arcing exists, replace igniter plug and gasket associated with damaged igniter lead and repair or replace damaged igniter lead.

(2) Inspect igniter lead terminals for deformation, cracks, chipping, or evidence of arcing. No damage is allowed.

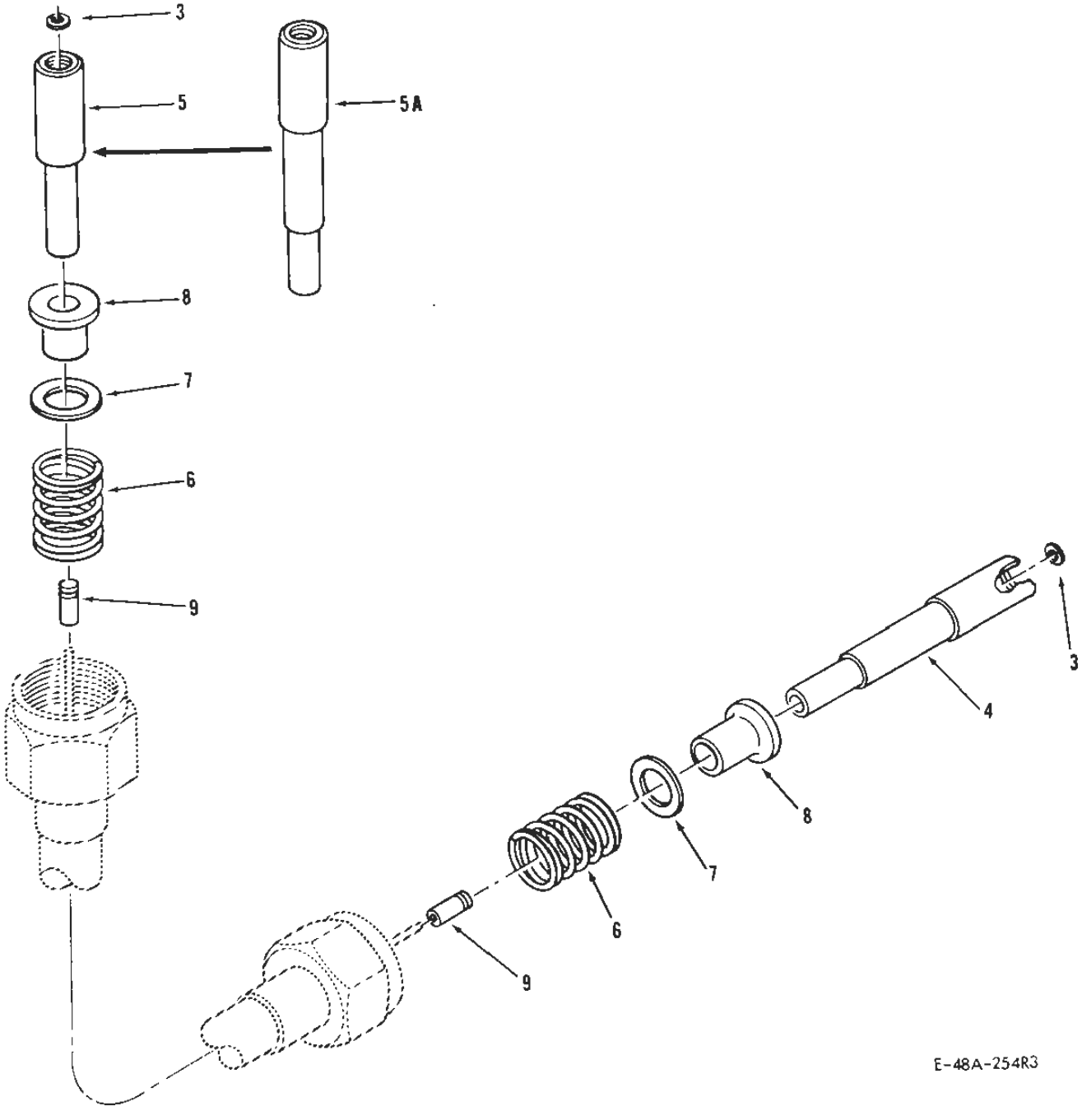
(3) Replace or repair igniter lead or lead terminals if inspection requirements are not met. (See figure 203.) Refer to 5, Approved Repairs.

C. Inspect Igniter Plugs

(1) Inspect igniter plug as follows

NOTE: An internal rattle may be evident when igniter plug is shaken. This is normal and is not cause for rejecting igniter plug.

(a) Visually inspect igniter plug for broken or missing parts. If igniter plug is broken or parts missing, replace plug.



3. SNAP RING (IPC FIG. 32)
4. TERMINAL (AT END OF LONG LEG)
5. TERMINAL (SHORT) (AT END OF SHORT LEG)
5A. TERMINAL (LONG) (AT END OF SHORT LEG) (ALTERNATE PART)
6. SPRING
7. RETAINER
8. GROMMET
9. SOCKET

Igniter Lead Terminal Replacement
Figure 203

3. C. (1) (b) Visually inspect center electrode and outer shell for erosion. If electrode is eroded 0.030 inch or more below end of ceramic insulator as shown in Figure 204, replace plug. Uniform erosion on electrode and outer shell is acceptable. Erosion of outer shell in spark gap area shall not exceed 0.330 inch diameter at insulator surface.

(c) Visually inspect ceramic insulator for cracks or chipped area as shown in Figure 204. Ensure normal ceramic insulator erosion is not misinterpreted as cracking. Replace igniter plug if ceramic insulator is damaged.

(d) Visually inspect outer shell for burned or flowed metal as shown in Figure 204. Replace plug if metal is burned or flowed.

(e) Visually inspect grommet mating flange of igniter plug for grooving. If grooved on one side 0.030 inch deep or more, replace plug.

(f) Visually inspect for clogged annular passage between insulator and outer shell. If clogged, clean by abrasive blasting (72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method No. 4) or replace plug. Do not use abrasive blasting on spark gap surface or interior of electrical connector.

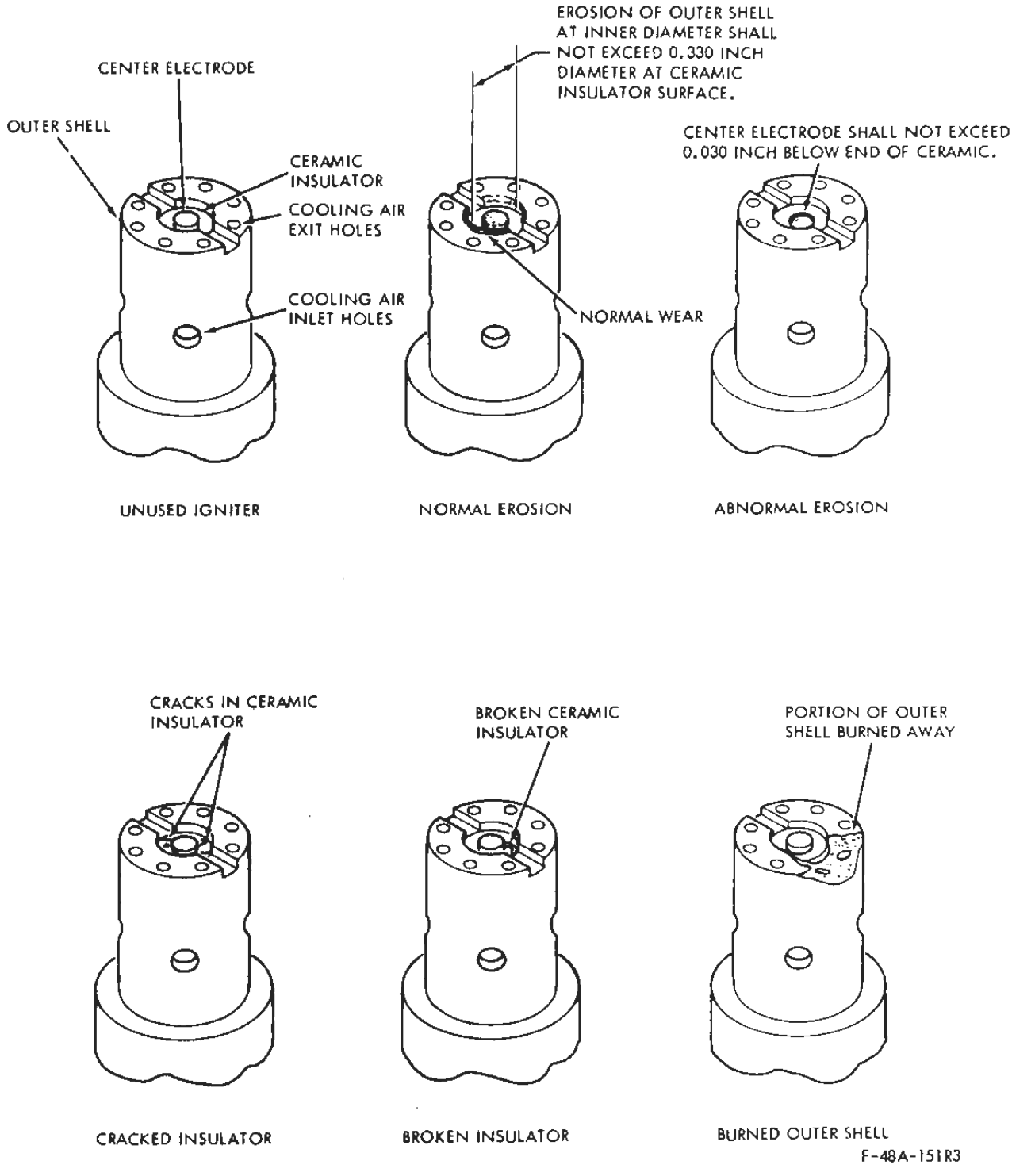
(g) Visually inspect for cracked or broken ceramic and bent, burned, or broken or loose pin in the igniter plug connector. Replace damaged plug.

(h) Visually inspect for cracked flanges. If cracked, replace plug.

4. Cleanig/Painting

A. Clean Parts

Clean parts as specified in Table 205 in accordance with cleaning methods provided in 72-00-00, GENERAL - CLEANING/PAINTING.



Igniter Plug Inspection
Figure 204

Table 205. Cleaning Methods

Figure No.	Item No.	Nomenclature	Cleaning Methods 1	2	3	4	5	6	7	8	9	10	11	12
All standard metallic hardware			X	X										
201	20,25 or 22,27	Igniter Lead											X	
	30	Ignition Unit											X	
	70, 125	Igniter Plug											X	
	55	Lock Plate	X	X			X	X						
	105	Mounting Bracket	X	X										

5. Approved Repairs

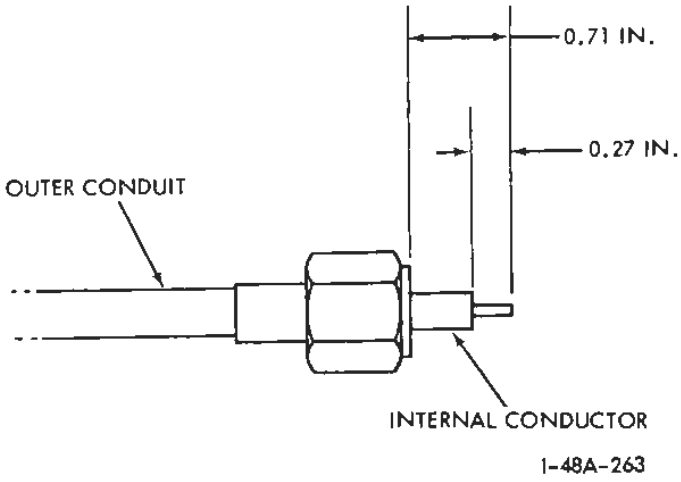
A. Repair Igniter Leads (Installed on Engine) (See Figure 203)

NOTE: The following repair procedure may be performed to replace a defective Wire Subassembly Part No. 110216-113, (Serviflex Corp, DBA, Servicair Co, 1841 Flower St, Glendale, CA 91201) (internal conductor) within the external igniter lead conduit with the igniter leads installed on the engine. AiResearch Repair Kit Part No. 3070873-1 may be used to repair either igniter lead. R

(1) Disconnect defective igniter lead at ignition unit and igniter plug in accordance with 1, Removal/Installation.

CAUTION: BENDING IGNITER LEADS WHEN DISCONNECTING FROM IGNITION UNIT WILL CAUSE DAMAGE TO INTERNAL INSULATION OF IGNITER LEADS. TO AVOID BENDING IGNITER LEADS, REMOVE IGNITION UNIT MOUNTING BOLTS BEFORE DISCONNECTING IGNITER LEADS FROM IGNITION UNIT.

(2) At end of igniter lead connecting to ignition unit, press terminal into igniter lead nut to expose snap ring and remove snap ring and terminal. Remove grommet, retainer and spring.



Trimming Replacement Internal Conductor for
Igniter Lead Repair
Figure 205

5. A. (3) Cut off crimped-on socket on internal conductor of igniter lead. Strip ends of inner conductor and end of replacement internal conductor opposite crimped-on socket. Twist stripped ends together and solder.

(4) At end of igniter lead connecting to igniter plug, press terminal into igniter lead end fitting to expose snap ring. Remove snap ring and terminal. Remove grommet, retainer, and spring.

CAUTION: IF ATTEMPT IS MADE TO PULL DEFECTIVE INTERNAL CONDUCTOR THROUGH CONDUIT WITHOUT FIRST REMOVING CRIMPED-ON SOCKET (STEP 3)), SOCKET WILL JAM IN IGNITER LEAD ELBOW.

(5) Pull replacement internal conductor in place, from end of igniter lead connecting with igniter plug, as defective internal conductor is pulled out.

NOTE: Either long or short terminal may have been removed at end of short leg on igniter lead. (See figure 203.) If short terminal was removed, short terminal shall be reinstalled for repair. If short terminal was removed and only long terminal is available for replacement, cut off long terminal 1.75 inches from large diameter end using sharp knife to convert long terminal to short terminal.

(6) Install long or short terminal (same type as removed in step (2)), grommet, retainer, and spring at ignition unit end of igniter lead and secure with snap ring. Push assembly securely against end fitting of igniter lead (do not compress spring).

(7) At opposite end of igniter lead, cut off replacement internal conductor 0.71 inch from point internal conductor extends through end fitting on igniter lead. Strip insulation 0.27 inch from end on internal conductor. (See figure 205.)

(8) Crimp Socket Part No. S3670-33 (Serviflex Corp, DBA Servicair Co, 1841 Flower St, Glendale, CA 91201) on wire using Servicair Co SAT-124 tool or equivalent.

(9) Install terminal, grommet, retainer and spring and secure with snap ring. To aid installing snap ring, terminal and spring may be compressed at ignition unit end of igniter lead.

5. A. (10) Test repaired igniter lead after conductor replacement as follows.

(a) Install ignition unit in accordance with 1, Removal/Instalation.

(b) Connect igniter plugs to igniter leads so sparking can be observed.

WARNING: ELECTRICAL DISCHARGE AT IGNITER PLUGS IS DANGEROUS. DO NOT COME IN CONTACT WITH IGNITER PLUG SPARK GAP WHEN IGNITER PLUGS ARE CONNECTED TO IGNITION UNIT. AT CONCLUSION OF CHECK, REMOVE STATIC CHARGE FROM IGNITER PLUGS BY SHORTING ACROSS SPARK GAP. USE SHIELDED JUMPER WIRE OR WELL INSULATED TOOL WHEN SHORTING SPARK GAP. CONDUCT TEST IN AREA FREE OF FLAMMABLE FLUIDS OR VAPORS.

(c) Connect 28 volt dc power source to ignition unit and observe igniter plugs. Check igniter plugs for spark rate of one spark per second minimum at 10 volts dc (higher rate at higher voltage).

(d) Remove 28 volts dc power source and igniter plugs used for check. Install components in accordance with 1, Removal/Installation.

B. Replacement of Lead Terminals

(1) Replace parts at lead terminals if they do not meet inspection requirements as follows. (See figure 203.)

(a) Press terminal into igniter lead nut to expose snap ring and remove snap ring and terminal. Removal of grommet, retainer, and spring is not required unless necessary to replace a defective part. Remove and reinstall serviceable parts if required.

R NOTE: Either long or short terminal may
R have been removed at end of short
R leg on igniter lead. (See figure
R 203.) If short terminal was
R removed, short terminal shall be
R reinstalled for repair. If short
R terminal was removed and only long
R terminal is available for replace-
R ment cut off long terminal 1.75
R inches from large diameter end us-
R ing sharp knife to convert long
R terminal to short terminal.

R 5. B. (1) (b) Install serviceable long or short terminal (same
R type as removed in step (a)) and secure with snap
R ring.

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72-00-72

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	212	Apr 30/80
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	215	June 29/79
	216	June 29/79
75-10-02	201 thru 204	Deleted
75-10-03	201 thru 210	Deleted
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	204	Blank
	205 FO	June 29/79
	206	Blank
	207	Apr 30/80
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RECORD OF TEMPORARY REVISIONS

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CHAPTER 75 - AIR

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GENERAL - DESCRIPTION AND OPERATION

1. Air

Compressor bleed airflow is available for airframe use at all engine operating levels and during all flight conditions.

R (Code C) (Codes A, B Pre SB72-3085) Compressor discharge air is bled through a boss on the engine plenum for engine anti-ice, when required.

Temperature and pressure of inlet air to the engine is sensed for use by the electronic computer for fuel scheduling purposes.

ENGINE ANTI-ICING - DESCRIPTION AND OPERATION

R 1. (Code C) (Codes A, B Pre SB72-3085) General

The engine anti-ice system is comprised of the anti-ice solenoid, anti-ice shutoff valve, and a pressure switch. These components allow the flow of compressor (bleed) air (P3) for anti-icing of the fan spinner. Control of the anti-ice airflow is through a cockpit switch and the anti-ice solenoid. The solenoid is a part of the solenoid controller valve and is covered in 76-10-01.

R 2. (Code C) (Codes A, B Pre SB72-3085) Anti-Ice Shutoff Valve

The pneumatic shutoff (anti-ice) valve is pneumatically controlled to supply engine anti-icing air. The valve is located at approximately the 12 o'clock position in the annular chamber between the low pressure compressor and the fan duct.

R 3. (Code C) (Codes A, B Pre SB72-3085) Anti-Ice Pressure Switch

The anti-ice pressure switch is activated by air pressure when the anti-ice valve is open and completes a circuit for a cockpit indicator when the anti-icing system is operating. The pressure switch is located on the fan duct.

4. Bleed Air Ducts

Low pressure bleed air is provided for airframe use at ports on the left and right hand sides of the fan outer duct. The bleed air is ported from the compressor case assembly through the bleed air ducts.

R (CODE C) (CODES A, B PRE SB72-3085)
ANTI-ICE VALVE INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
High vacuum grease (Dow Corning 971V)	Dow Corning Corp, S Saginaw Rd, Midland, MI 48640

A. (Codes A, B) Remove Anti-Ice Pressure Switch (See Figure 201)

NOTE: (Post SB72-3040) Refer to paragraph B for removal of alternate configuration.

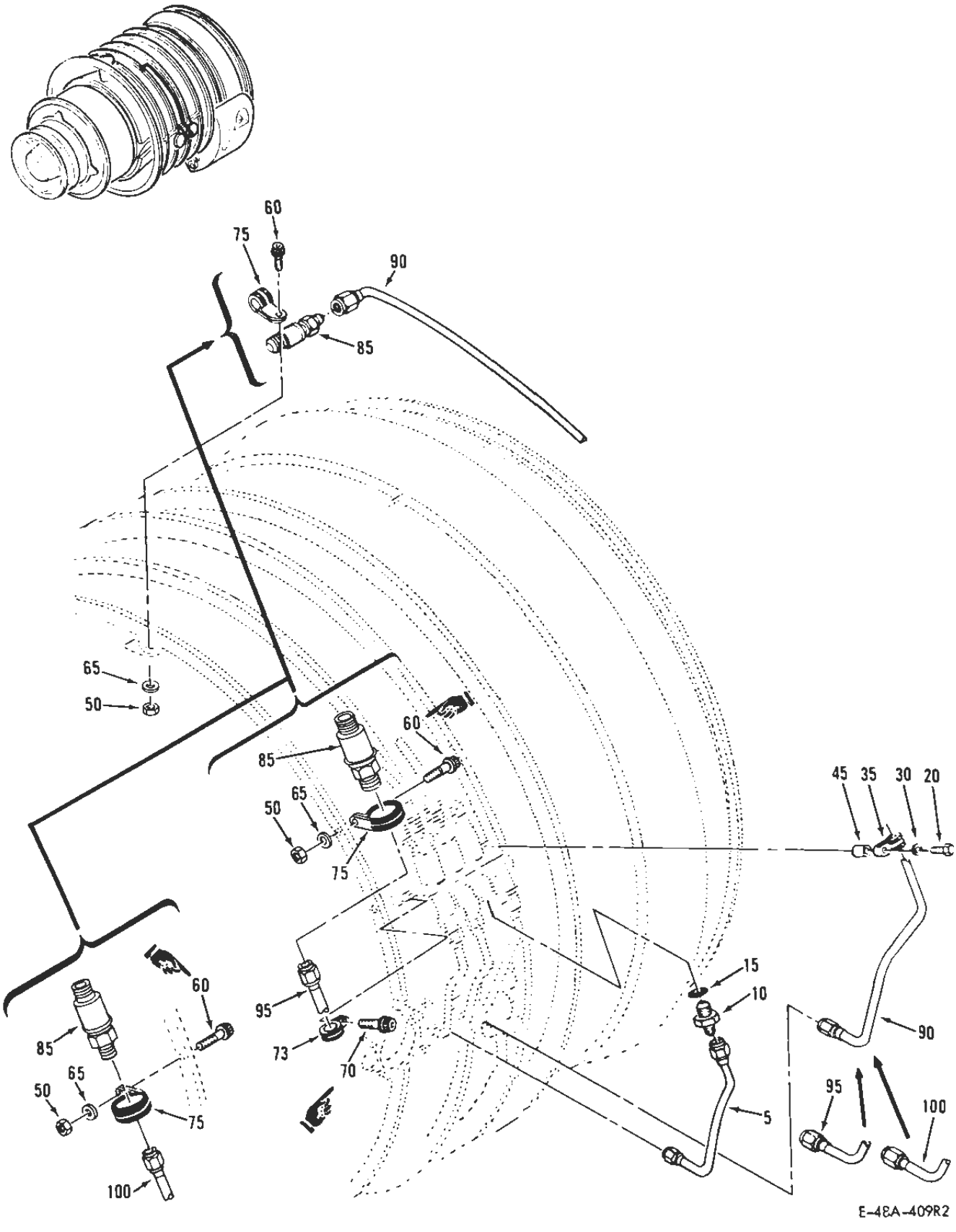
(1) Remove tube assembly, union, and packing connected to solenoid controller valve.

(2) (Codes A, B Pre SB72-3040) Remove bolt, washer, clamp, and spacer securing tube assembly to anti-ice pressure switch and remove tube assembly.

(3) (Code A Post SB72-3040) Remove tube assembly to anti-ice pressure switch.

(4) (Code B Post SB72-3040) Remove bolt and clamp securing tube assembly to anti-ice pressure switch, then remove tube assembly.

(5) Remove nut, washer, bolt, and clamp securing anti-ice pressure switch and remove switch.



R (Codes A, B Pre SB72-3085)
Anti-Ice Air Pressure Switch Installation
Figure 201

1. B. (Code A Post SB72-3040) Remove Anti-Ice Pressure Switch (See Figure 202)

NOTE: (Code A) Refer to paragraph A for removal of alternate configuration.

(1) Remove tube assembly, union, and packing connected to solenoid controller valve.

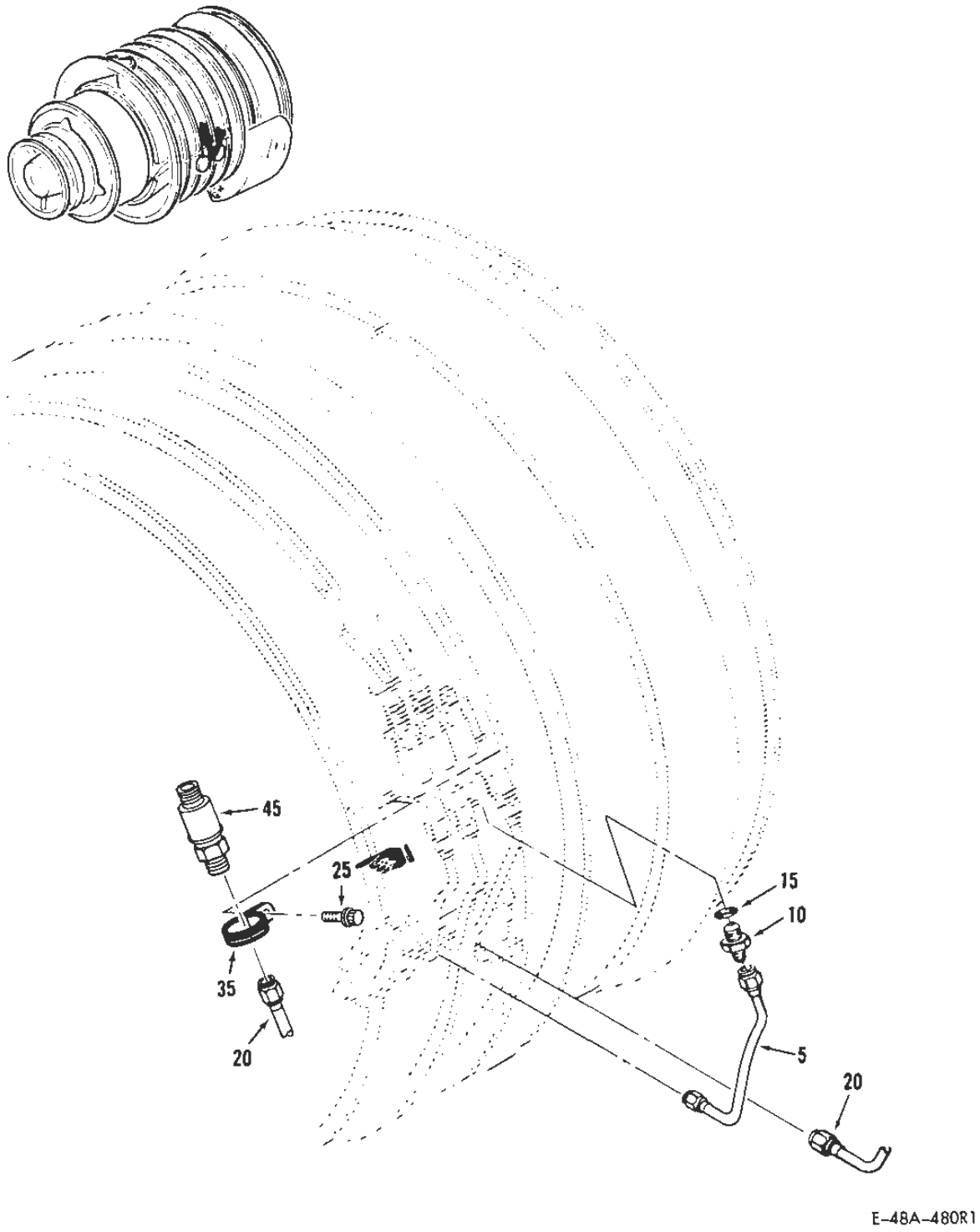
(2) Remove tube assembly connected to anti-ice pressure switch.

(3) Remove bolt and clamp securing anti-ice pressure switch, then remove switch.

KEY TO FIGURE 201

R	5.	TUBE ASSY (IPC FIG. 34)		65.	WASHER
R	10.	UNION	**	70.	BOLT
R	15.	PACKING	**	73.	CLAMP
R	*20.	BOLT		75.	CLAMP
R	*30.	WAHSER		85.	PRESSURE SWITCH
R	*35.	CLAMP	**	90.	TUBE ASSY
R	*45.	SPACER	**	95.	TUBE ASSY
R	50.	NUT	**100.		TUBE ASSY

R *(CODES A, B PRE SB72-3040)
R **(CODES A, B POST SB72-3040)



5. TUBE ASSY (IPC FIG. 35)
10. UNION
15. PACKING
20. TUBE ASSY
25. BOLT
35. CLAMP
45. PRESSURE SWITCH

R (Code A Post SB72-3040, Pre SB72-3085)
Anti-Ice Air Pressure Switch Installation
Figure 202

1. C. (Code C) Remove Anti-Ice Pressure Switch (See Figure 203)

(1) Remove nut, bolt, spacer, and clamps securing tube assembly connected to solenoid controller valve.

(2) Remove tube assembly, union, and packing connected to solenoid controller valve.

(3) Remove tube assembly to anti-ice pressure switch.

(4) Remove nut, washer, bolt, and clamp securing anti-ice pressure switch, then remove switch.

D. (Codes A, B) Install Anti-Ice Pressure Switch (See Figure 201)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(Code A Post SB72-3040) Refer to paragraph E for installation of alternate configuration.

(1) Install clamp on anti-ice pressure switch and secure clamp with nut, washer, and bolt. Do not fully tighten nut and bolt until tube assembly for switch is installed.

(2) (Codes A, B Pre SB72-3040) Install tube assembly to anti-ice pressure switch. Secure tube assembly with spacer, clamp, washer, and bolt. Tighten bolt (20) to torque of 50 inch-pounds. Tighten nut (50) to torque of 40 inch-pounds.

(3) (Code A Post SB72-3040) Install tube assembly to anti-ice pressure switch. Tighten bolt (60) to torque of 50 inch-pounds.

i. C. (4) (Code B Post SB72-3040) Install tube assembly to anti-ice pressure switch. Secure tube assembly with clamp and bolt. Tighten bolt (70) to torque of 50 inch-pounds. Tighten bolt (60) to torque of 50 inch-pounds.

(5) Install packing on union and install union in solenoid controller valve. Install tube assembly to union.

E. (Code A Post SB72-3040) Install Anti-Ice Pressure Switch (See Figure 202)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(Code A Post SB72-3040) Refer to paragraph D for installation of alternate configuration.

(1) Install clamp on anti-ice pressure switch and secure clamp with bolt. Do not fully tighten bolt until tube assembly for switch is installed.

(2) Install tube assembly to anti-ice pressure switch. Tighten bolt (25) to torque of 50 inch-pounds.

(3) Install packing on union and install union in solenoid controller valve. Install tube assembly to union.

F. (Code C) Install Anti-Ice Pressure Switch (See Figure 203)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Install clamp on anti-ice pressure switch and secure clamp with nut, washer, and bolt. Do not fully tighten bolt until tube assembly for anti-ice pressure switch is installed.

(2) Install tube assembly to anti-ice pressure switch. Tighten bolt (55) to torque of 40 inch-pounds.

(3) Install union and packing in solenoid controller valve. Install tube assembly to union. Secure tube assembly with clamps, spacer, nut, and bolt. Tighten nut (5) to torque of 30 inch-pounds.

R 1. G. Remove Anti-Ice Valve and Manifold (See Figure 204)

(1) (Code A) Remove engine wiring harness in accordance with 72-00-02, MAINTENANCE PRACTICES.

(2) (Pre SB72-3040) Remove fuel heater or oil to cooler tube installation in accordance with 79-20-06, MAINTENANCE PRACTICES.

(3) (Pre SB72-3040) Remove fuel/oil cooler installation in accordance with 79-20-07, MAINTENANCE PRACTICES.

(4) (Pre SB72-3040) Remove tubes from oil tank to oil pump and accessory drive gearbox in accordance with 79-10-01, MAINTENANCE PRACTICES.

(5) (Pre SB72-3040) Remove fuel and P3 sensing lines installation in accordance with 73-10-02, MAINTENANCE PRACTICES.

(6) (Pre SB72-3040) Remove oil pump and chip detector installation in accordance with 79-20-03, MAINTENANCE PRACTICES.

(7) (Pre SB72-3040) Remove fuel system installation in accordance with 73-20-01, MAINTENANCE PRACTICES.

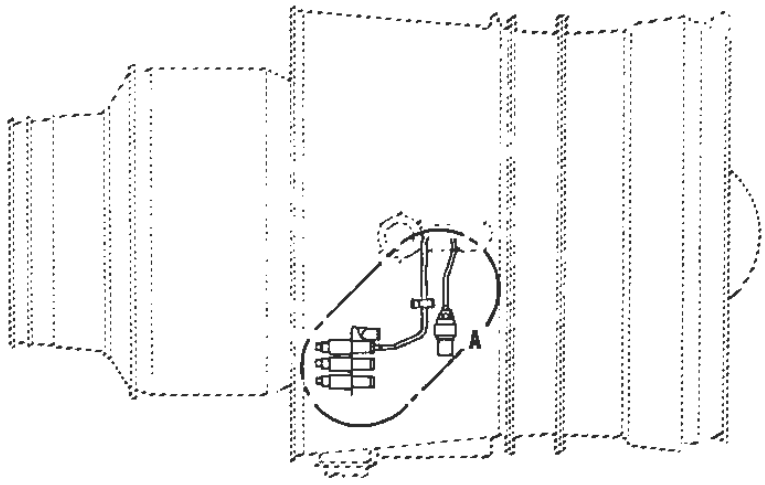
(8) (Pre SB72-3040) Remove accessory and transfer gearbox installation in accordance with 72-60-01, MAINTENANCE PRACTICES.

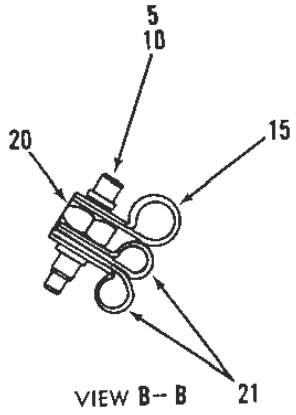
(9) Remove ignition unit and remove lockplate and grommet securing igniter leads to outer duct in accordance with 74-00-01, MAINTENANCE PRACTICES.

(10) (Codes A, B) Remove pneumatic tube to anti-ice pressure switch in accordance with paragraphs 1.A, 1.B, or 1.C.

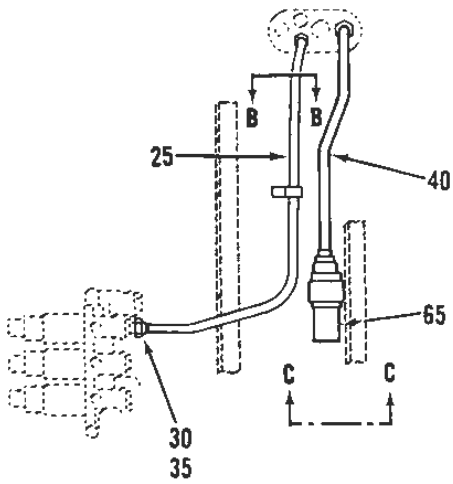
(11) (Codes A, B) Remove solenoid controller valve and attached pneumatic tubes in accordance with 76-10-01, MAINTENANCE PRACTICES.

(12) (Pre SB72-3040) Remove right side duct, oil-out tube, left side fairing, and oil inlet tube in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 201.)

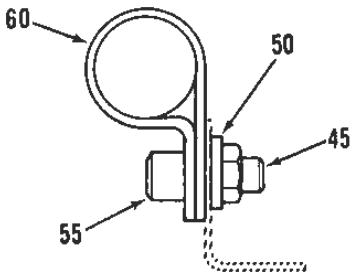




VIEW B-B



DETAIL A



VIEW C-C

F-48A-276R1

(Codes C) Anti-Ice Air Pressure Switch Installation
Figure 203

1. G. (13) (Pre SB72-3040) Remove bottom duct rib and oil transfer tubes in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 202.)

(14) (Pre SB72-3040) Remove bleed air ducts in accordance with 75-10-05, MAINTENANCE PRACTICES.

(15) (Pre SB72-3040) Remove fan duct assembly in accordance with 72-70-05, MAINTENANCE PRAACTICES.

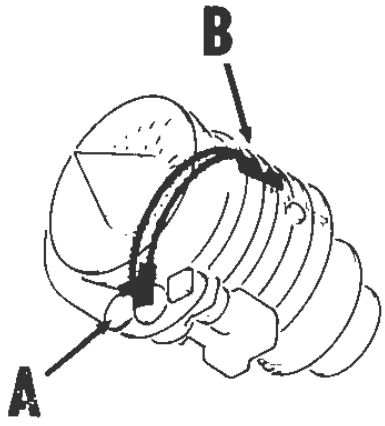
(16) (Post SB 72-3040) Remove upper half of fan duct set in accordance with 72-70-05, MAINTENANCE PRACTICES for access to upper oil (air/oil) cooler.

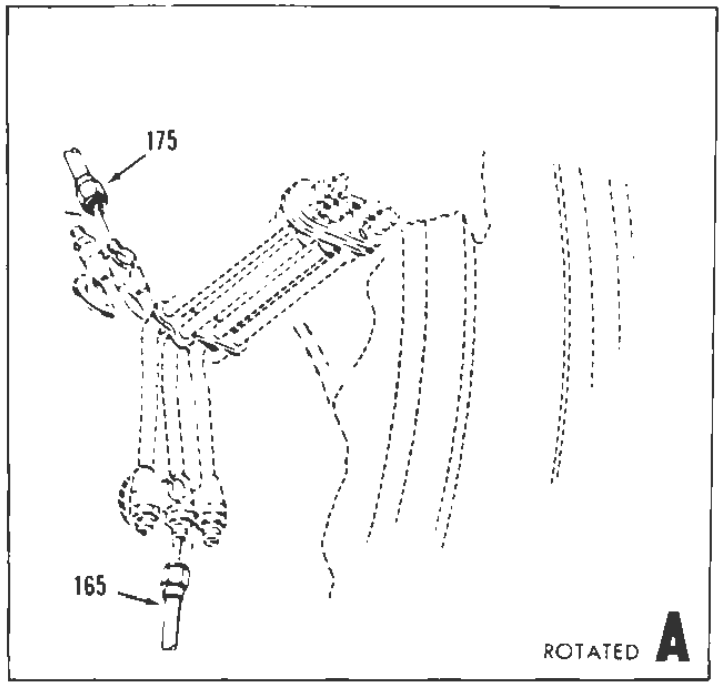
(17) Remove left and right side panels in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 203.)

(18) Remove upper air/oil cooler in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 204 or 205.)

KEY TO FIGURE 203

5. NUT (IPC FIG. 36)
10. BOLT (PART ADDED)
15. CLAMP (PART ADDED)
20. SPACER (PART ADDED)
21. CLAMP (PART ADDED)
25. TUBE ASSY
35. PACKING
35. PACKING
40. TUBE ASSY
45. NUT
50. WASHER
55. BOLT
60. CLAMP
65. PRESSURE SWITCH





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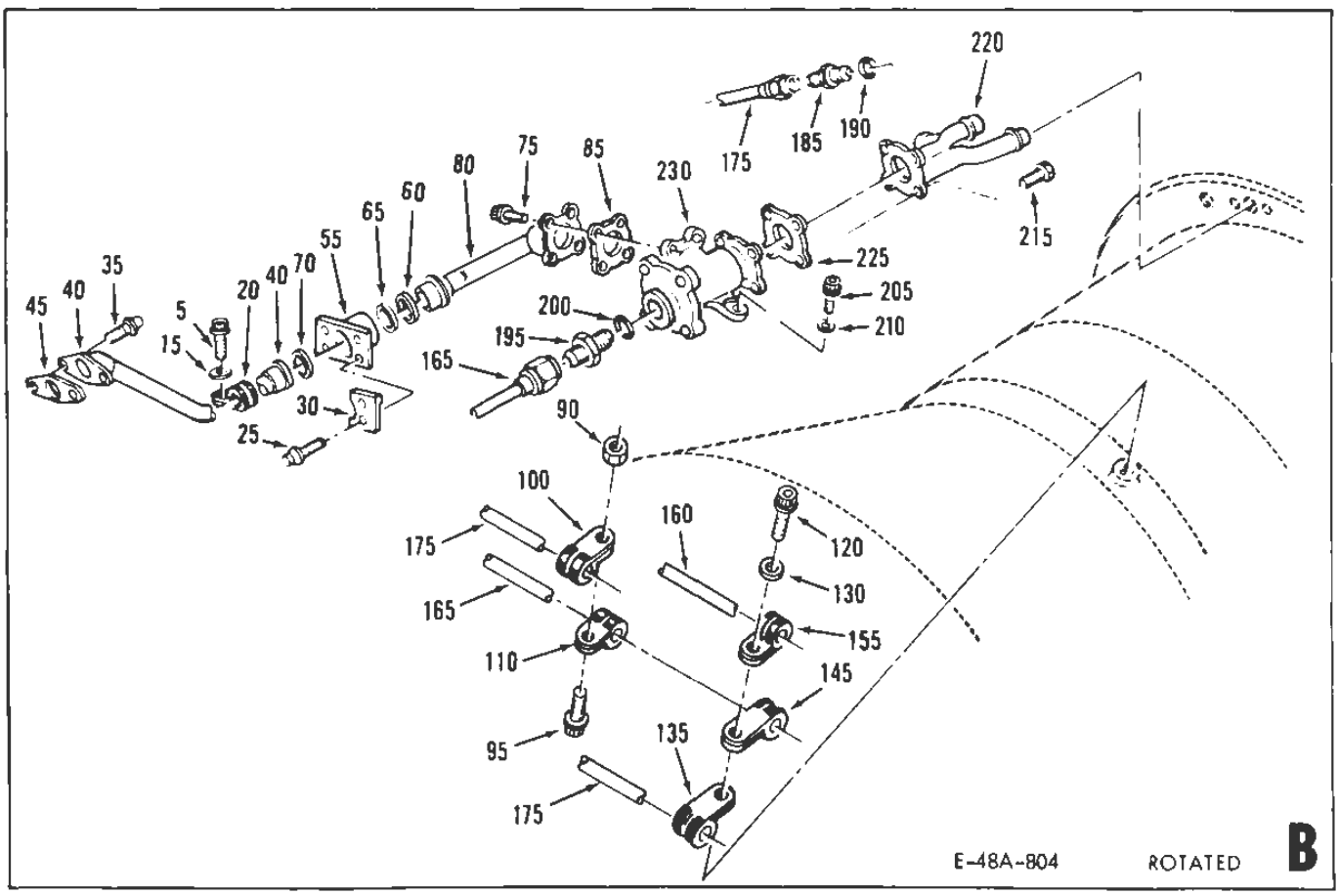


R (Code C) (Codes A, B Pre SB72-3085)
R Anti-Ice Valve and Manifold Installation
Figure 204

1. G. (19) Remove nuts, bolts, washers, and clamps securing tube assemblies connected to unions on anti-ice valve and manifold. Remove tube assemblies.

(20) Remove bolts and clamp securing anti-ice air transfer tubes. Remove anti-ice air transfer tubes, tube retainer, gaskets, seal, seal housing, and retaining ring.

(21) Remove bolts and washers securing anti-ice valve, then remove anti-ice valve with manifold.

(22) Remove unions and gaskets from anti-ice valve and manifold.

(23) Remove bolts securing manifold to anti-ice valve, then remove manifold and gasket.

R H. Install Anti-Ice Valve and Manifold (See Figure 204)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Assemble manifold and new gasket on anti-ice valve and secure with bolts. Tighten bolts (215) to torque of 40 inch-pounds.

(2) Install unions with new gaskets in anti-ice valve and manifold.

KEY TO FIGURE 204

5.	BOLT (IPC FIG. 37)	75.	BOLT	175.	TUBE ASSY
15.	WASHER (PART DELETED)	80.	ANTI-ICE AIR XFR TUBE	185.	UNION
20.	CLAMP	85.	GASKET	190.	GASKET
25.	BOLT	90.	NUT	195.	UNION
30.	TUBE RETAINER	95.	BOLT	200.	GASKET
40.	ANTI-ICE AIR XFR TUBE	100.	CLAMP	205.	BOLT
45.	ANTI-ICE GASKET	110.	CLAMP	210.	WASHER
55.	SEAL HOUSING	120.	BOLT	215.	BOLT
60.	RETAINING RING	130.	WASHER	220.	MANIFOLD
65.	AXIAL C-TYPE SEAL	135.	CLAMP	225.	GASKET
70.	GASKET	145.	CLAMP	230.	ANTI-ICE VALVE
		155.	CLAMP		
		165.	TUBE ASSY		

1. H. (3) Position assembled anti-ice valve and manifold on engine. Secure assembly to engine with washers and bolts. Tighten bolts (205) to torque of 40 inch-pounds.

(4) Install anti-ice air transfer tubes, tube retainer, new gaskets, seal, seal housing and retaining ring. Assemble seal, seal housing, and retaining ring to join anti-ice air transfer tubes as shown in Figure 205. Secure assembly with bolts and tube retainer. Tighten bolts (25) to torque of 40 to 50 inch-pounds.

(5) Attach anti-ice air transfer tubes and assembled parts to anti-ice valve and combustion chamber plenum case with bolts, clamp, and new gaskets. When gasket (45) used is not fully metallic, coat both sides of gasket with high vacuum grease (Dow Corning 971V) prior to assembly. Tighten bolt (5) to torque of 50 inch-pounds and bolts (35) to torque of 60 to 70 inch-pounds. Tighten bolts (75) to torque of 40 inch-pounds.

(6) Install tube assemblies on unions on anti-ice valve and manifold. Secure tube assemblies with clamps, nut, washer, and bolts. Tighten bolts (95, 120) to torque of 40 inch-pounds.

(7) Install upper oil (air/oil) cooler in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 204 or 205, as applicable.)

(8) Install left and right side panels in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 203.)

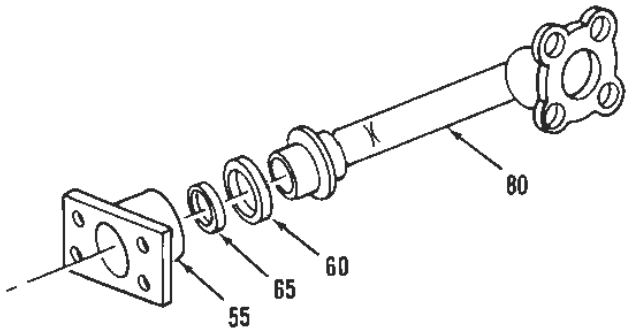
(9) (Pre SB72-3040) Install fan duct assembly in accordance with 72-70-05, MAINTENANCE PRACTICES.

(10) (Post SB72-3040) Install upper half of fan duct set in accordance with 72-70-05, MAINTENANCE PRACTICES.

(11) (Pre SB72-3040) Install bleed air ducts in accordance with 75-10-05, MAINTENANCE PRACTICES.

(12) (Pre SB72-3040) Install bottom duct rib and oil transfer tubes in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 202.)

(13) (Pre SB72-3040) Install right side duct, oil out tube, left side fairing, and oil inlet tube in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 201.)



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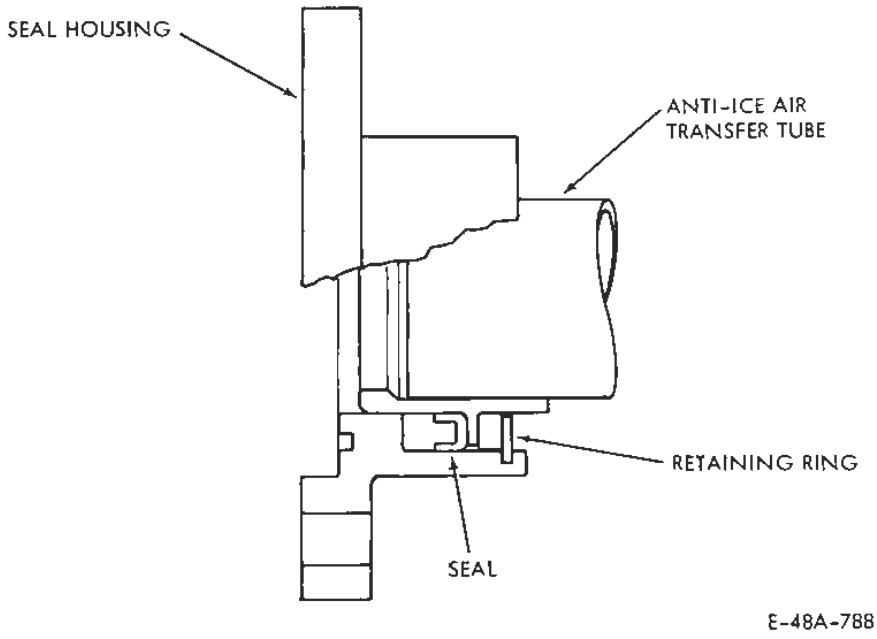


R 55. SEAL HOUSING (IPC FIG. 37)
R 60. RETAINING RING
R
65. SEAL
80. ANTI-ICE AIR TRANSFER TUBE

Installation of Seal on Anti-Ice Air Transfer Tube
Figure 205

1. H. (14) (Codes A, B) Install solenoid controller valve and attached pneumatic tubes in accordance with 76-10-01, MAINTENANCE PRACTICES.

(15) Install anti-ice pressure switch in accordance with paragraph 1.D, 1.E, or 1.F.

(16) Install ignition unit and secure igniter leads in accordance with 74-00-01, MAINTENANCE PRACTICES.

(17) (Pre SB72-3040) Install accessory and transfer gearbox installation in accordance with 72-60-01, MAINTENANCE PRACTICES.

(18) (Pre SB72-3040) Install fuel system installation in accordance with 73-20-01, MAINTENANCE PRACTICES.

(19) (Pre SB72-3040) Install oil pump and chip detector installation in accordance with 79-20-03, MAINTENANCE PRACTICES.

(20) (Pre SB72-3040) Install fuel and P3 sensing lines installation in accordance with 73-10-02, MAINTENANCE PRACTICES.

(21) (Pre SB72-3040) Install tubes from oil tank to oil pump and accessory drive gearbox in accordance with 79-10-01, MAINTENANCE PRACTICES.

(22) (Pre SB72-3040) Install fuel/oil cooler installation in accordance with 79-20-07, MAINTENANCE PRACTICES.

(23) (Pre SB72-3040) Install fuel heater or oil to cooler tube installation in accordance with 79-20-06, MAINTENANCE PRACTICES.

(24) (Code A) Install engine wiring harness in accordance with 72-00-02, MAINTENANCE PRACTICES.

2. Inspection/Check

A. Inspect Pressure Switch

(1) Inspect pneumatic fitting threads for visible damage.

(2) Inspect electrical connector for visible damage.

(3) Check pressure port for foreign material.

(4) Check pressure switch as follows.

(a) Connect variable pressure source to pneumatic fitting on pressure switch and connect ohmmeter across pins A and B of electrical connector. Ohmmeter shall indicate an open circuit with no pressure applied.

(b) Increase pressure at fitting until switch activates (continuity indicated across pins A and B). Pressure at which switching occurs shall be 6 $\pm$1 psig.

(c) Decrease pressure at fitting until switch deactivates (open circuit indicated across pins A and B). Pressure at which switching occurs shall be no less than 3 psig.

(5) Replace switch if it does not meet inspection requirements of steps (1) through (4).

B. Inspect Pneumatic Tubes

(1) Inspect tubes for corrosion, cracked flares, or dents which cause a crease or reduce diameter more than ten percent.

(2) Inspect for damaged sleeves or nuts.

(3) Inspect threads on fittings that have been disconnected for visible damage.

(4) Replace tubes if corrosion, cracked flares, dents causing a crease or reducing diameter more than ten percent, damaged sleeves or nuts, or damaged threads are evident.

2. C. Inspect Anti-Ice Valve and Manifold

(1) Inspect anti-ice valve for cracks or corrosion. Ensure vent holes in valve body are free of obstructions.

(2) Inspect manifold for cracks, corrosion, and evidence of leakage. Inspect ferrules on tubing inserted into engine support housing for cracks, chafing, and evidence of improper mating with air transfer tube. Check condition of seal in tube of manifold and ensure seal is properly secured by peening of manifold end.

3. Cleaning/Painting

A. Clean Parts

(1) Clean parts as specified in Table 202 in accordance with cleaning methods provided in 72-00-00, GENERAL-CLEANING/PAINTING.

Table 202. Cleaning Methods

Figure No.	Item No.	Nomenclature	Cleaning Method 1	2	3	4	5	6	7	8	9	10	11	12
All standard metallic hardware			X	X										
Plumbing and fittings														X
201	85	Switch											X	
202	45	Switch											X	
203	65	Switch											X	
204	30	Retainer	X	X							X			
	55	Housing	X	X										
	220	Manifold	X	X										

BLEED AIR DUCT INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Lubricating compound (Liqui-Moly, Grade NV, thread compound)	Lockrey Co, Lubricants Div, Cedar Shores, Southampton, NY 11968

A. Remove Bleed Air Duct Seals (See Figure 201)

(1) Remove bolts and washers securing bleed air port covers. Remove bleed air port covers and gaskets.

(2) Remove screws securing outer flanges, then remove outer flanges.

(3) Slip bleed air ducts out from engine to allow removal of inner and outer seals installed on bleed air ducts.

(4) Remove seals.

B. Install Bleed Air Duct Seals (See Figure 201)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Install new seals on each end of bleed air ducts.

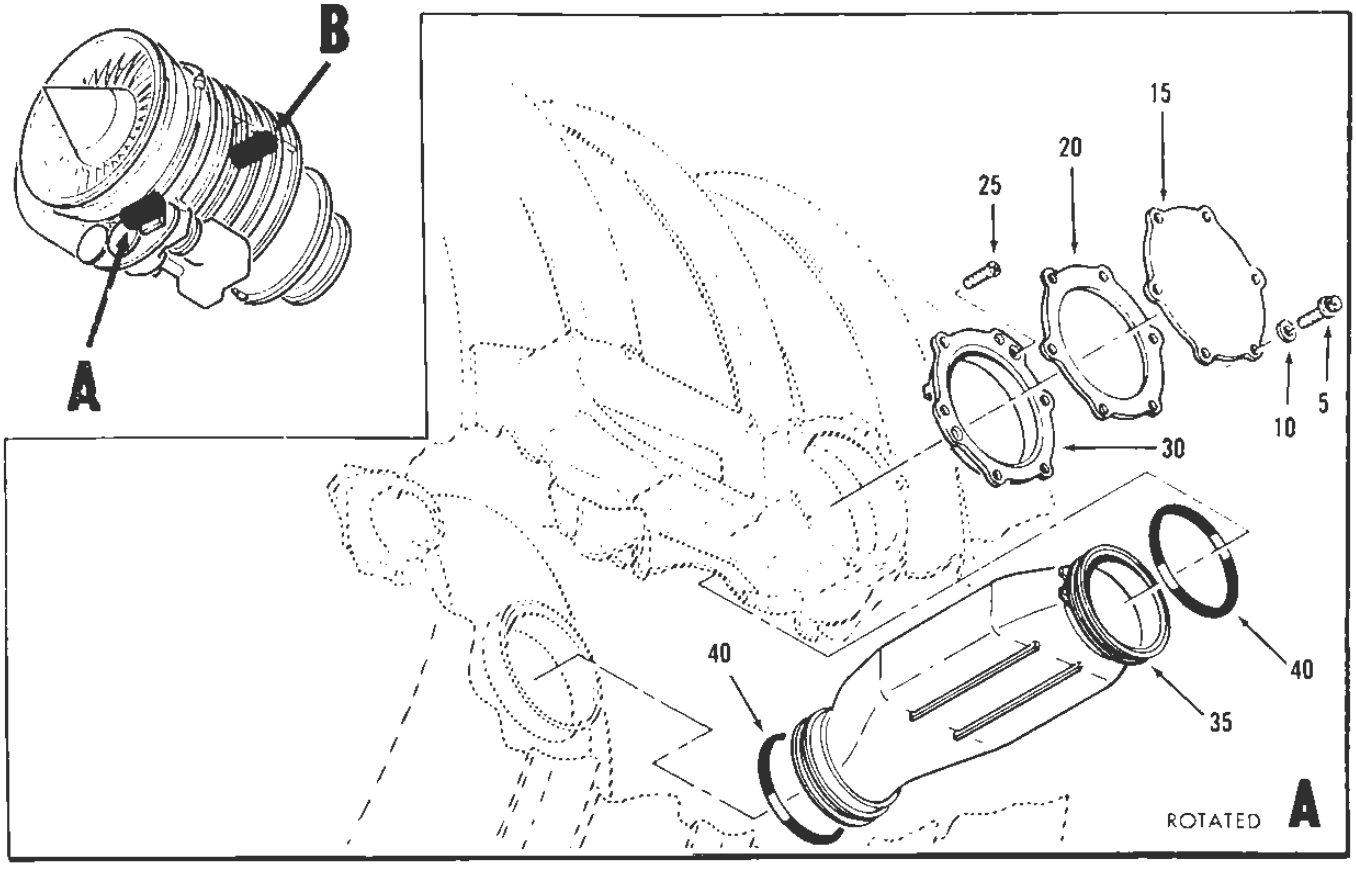
(2) Slip bleed air ducts inward to normal installed position.

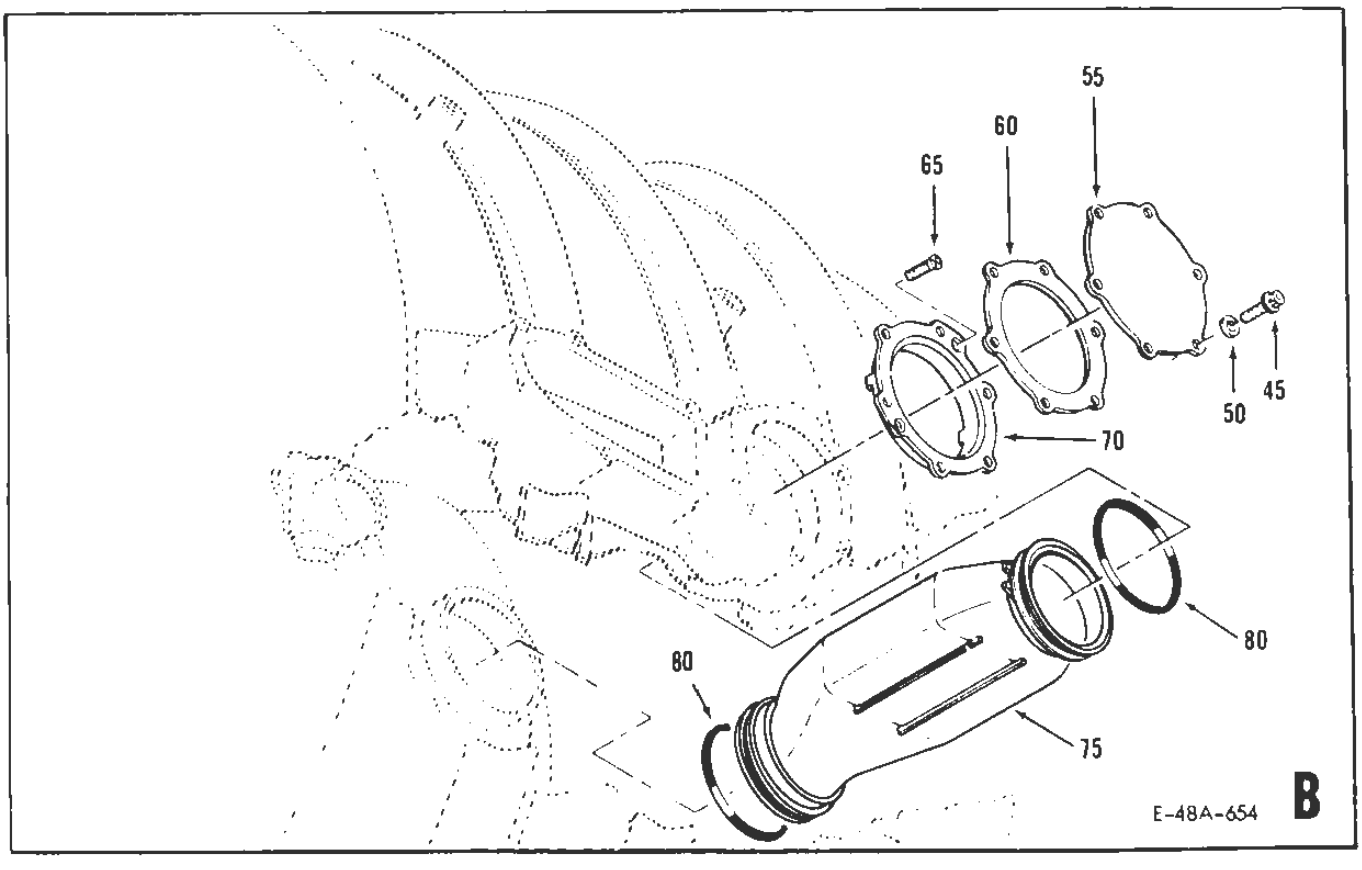
(3) Apply lubricating compound (Liqui-Moly, Grade NV, thread compound) to threads of screws and bolts used to secure outer flanges and bleed air port covers.

(4) Install outer flanges, then secure with screws. Tighten screws (8, 17) to torque of 30 inch-pounds.

(5) Install gaskets and bleed air port covers, then secure with bolts and washers. Tighten bolts (3, 12) to torque of 40 inch-pounds.

R





Bleed Air Duct Installation
Figure 201

1. C. Remove Bleed Air Ducts (See Figure 201)

(1) (Code A) Remove engine wiring harness in accordance with 72-00-02, MAINTENANCE PRACTICES.

(2) Remove fuel heater or oil to cooler tube installation in accordance with 79-20-06, MAINTENANCE PRACTICES.

(3) Remove fuel/oil cooler installation in accordance with 79-20-07, MAINTENANCE PRACTICES.

(4) Remove tubes from oil tank to oil pump and accessory drive gearbox in accordance with 79-10-01, MAINTENANCE PRACTICES.

(5) Remove fuel and P3 sensing tubes installation in accordance with 73-10-02, MAINTENANCE PRACTICES.

(6) Remove fuel system installation in accordance with 73-20-01, MAINTENANCE PRACTICES.

(7) Remove oil pump and chip detector installation in accordance with 79-20-03, MAINTENANCE PRACTICES.

(8) Remove accessory and transfer gearbox installation in accordance with 72-60-01, MAINTENANCE PRACTICES.

(9) Remove ignition unit, lockplate, and grommet securing igniter leads to fan duct assembly or set in accordance with 74-00-01, MAINTENANCE PRACTICES.

R (10) (Code C) (Codes A, B Pre SB72-3085) Remove pneumatic tube to anti-ice pressure switch, pressure switch, and tube to solenoid controller valve in accordance with 75-10-01, MAINTENANCE PRACTICES.

KEY TO FIGURE 201

R 5. BOLT (IPC FIG. 18)
R 10. WASHER
R 15. BLEED AIR PORT COVER
R 20. BLEED AIR PORT GASKET
R 25. SCREW
R 30. OUTER FLANGE
R 35. LP BLEED AIR DUCT
R 40. SEAL
45. BOLT
50. WASHER
55. BLEED AIR PORT COVER
60. BLEED AIR PORT GASKET
65. SCREW
70. OUTER FLANGE
75. LP BLEED AIR DUCT
80. SEAL

1. C. (11) Remove solenoid controller valve and attached tubes in accordance with 76-10-01, MAINTENANCE PRACTICES.

(12) Remove right side duct, oil-out tube, left side fairing, and oil inlet tube in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 201.)

(13) Remove bottom duct rib and oil transfer tubes in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 202.)

(14) Remove bolts and washers securing bleed air port covers. Remove bleed air port covers and gaskets.

(15) Remove screws securing outer flanges, then remove outer flanges.

(16) Remove nuts, washers, bolts, and screws securing fan duct assembly or set to engine support housing in accordance with 72-70-05, MAINTENANCE PRACTICES.

(17) Remove bleed air ducts with assembled seals, then remove seals.

D. Install Bleed Air Ducts (See Figure 201)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Install new seals at each end of bleed air ducts.

(2) With fan duct assembly or set unfastened from engine support housing, install bleed air ducts and seat in normally installed position.

(3) Secure fan duct assembly or set to engine support housing with screws, bolts, washers, and nuts in accordance with 72-70-05, MAINTENANCE PRACTICES.

(4) Apply a light coat of lubricating compound (Liqui-Moly, Grade NV, thread compound) to threads of screws and bolts used to secure outer flanges and bleed air port covers.

(5) R Install outer flanges, then secure with screws. Tighten screws (25, 65) to torque of 30 inch-pounds.

(6) R Install gaskets and bleed air port covers, then secure with bolts and washers. Tighten bolts (5, 45) to torque of 40 inch-pounds.

1. D. (7) Install bottom duct rib and oil transfer tubes in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 202.)

(8) Install right side duct, oil-out tube, left side fairing, and oil inlet tube in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 201.)

(9) Install solenoid controller valve and attached tubes in accordance with 76-10-01, MAINTENANCE PRACTICES.

R (10) (Code C) (Codes A, B Pre SB72-3085) Install pneumatic tube to anti-ice pressure switch, pressure switch, and pneumatic tube to solenoid controller valve in accordance with 75-10-01, MAINTENANCE PRACTICES.

(11) Install lockplate and grommet securing igniter leads to fan duct assembly or set and install ignition unit in accordance with 74-00-01, MAINTENANCE PRACTICES.

(12) Install accessory and transfer gearbox installation in accordance with 72-60-01, MAINTENANCE PRACTICES.

(13) Install oil pump and chip detector installation in accordance with 79-20-03, MAINTENANCE PRACTICES.

(14) Install fuel system installation in accordance with 73-20-01, MAINTENANCE PRACTICES.

(15) Install fuel and P3 sensing lines installation in accordance with 73-10-02, MAINTENANCE PRACTICES.

(16) Install tubes from oil tank to oil pump and accessory drive gearbox in accordance with 79-10-01, MAINTENANCE PRACTICES.

(17) Install fuel/oil cooler installation in accordance with 79-20-07, MAINTENANCE PRACTICES.

(18) Install fuel heater or oil to cooler tube installation in accordance with 79-20-06, MAINTENANCE PRACTICES.

(19) (Code A) Install engine wiring harness in accordance with 72-00-02, MAINTENANCE PRACTICES.

2. Inspection/Check

A. Inspect Bleed Air Ducts

Inspect bleed air ducts for corrosion, cracks, dents, or distortion. Replace bleed air ducts if corrosion, cracks, dents, or distortion are evident.

3. Cleaning/Painting

A. Clean Parts

Clean parts as specified in Table 202 in accordance with cleaning methods provided in /2-00-00, GENERAL - CLEANING/PAINTING.

Table 202. Cleaning Methods

	Figure No.	Item No.	Nomenclature	Cleaning Methods 1	2	3	4	5	6	7	8	9	10	11	12
	All standard metallic hardware			X	X										
R	201	15, 55	Cover	X	X			X	X						
R		30, 70	Flange										X		
R		35, 75	Duct	X	X							X			

INLET PRESSURE AND TEMPERATURE SENSOR INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove Inlet Pressure and Temperature Sensor (See Figure 201)

(1) Disconnect wiring harness electrical connector from sensor.

(2) Disconnect pneumatic tube from pneumatic port on sensor.

R R (3) (Codes A, B) Remove bolts and washers securing sensor to engine. Remove sensor and sensor gasket.

(4) (Code C) Remove remotely mounted sensor and sensor gasket in accordance with Aircraft Maintenance Manual.

(5) (Code C) Remove bolts and washers securing plate and sensor gasket to engine. Remove plate and sensor gasket.

B. Install Inlet Pressure and Temperature Sensor (See Figure 201)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) (Codes A, B) Position sensor and sensor gasket on engine and secure with bolts and washers.

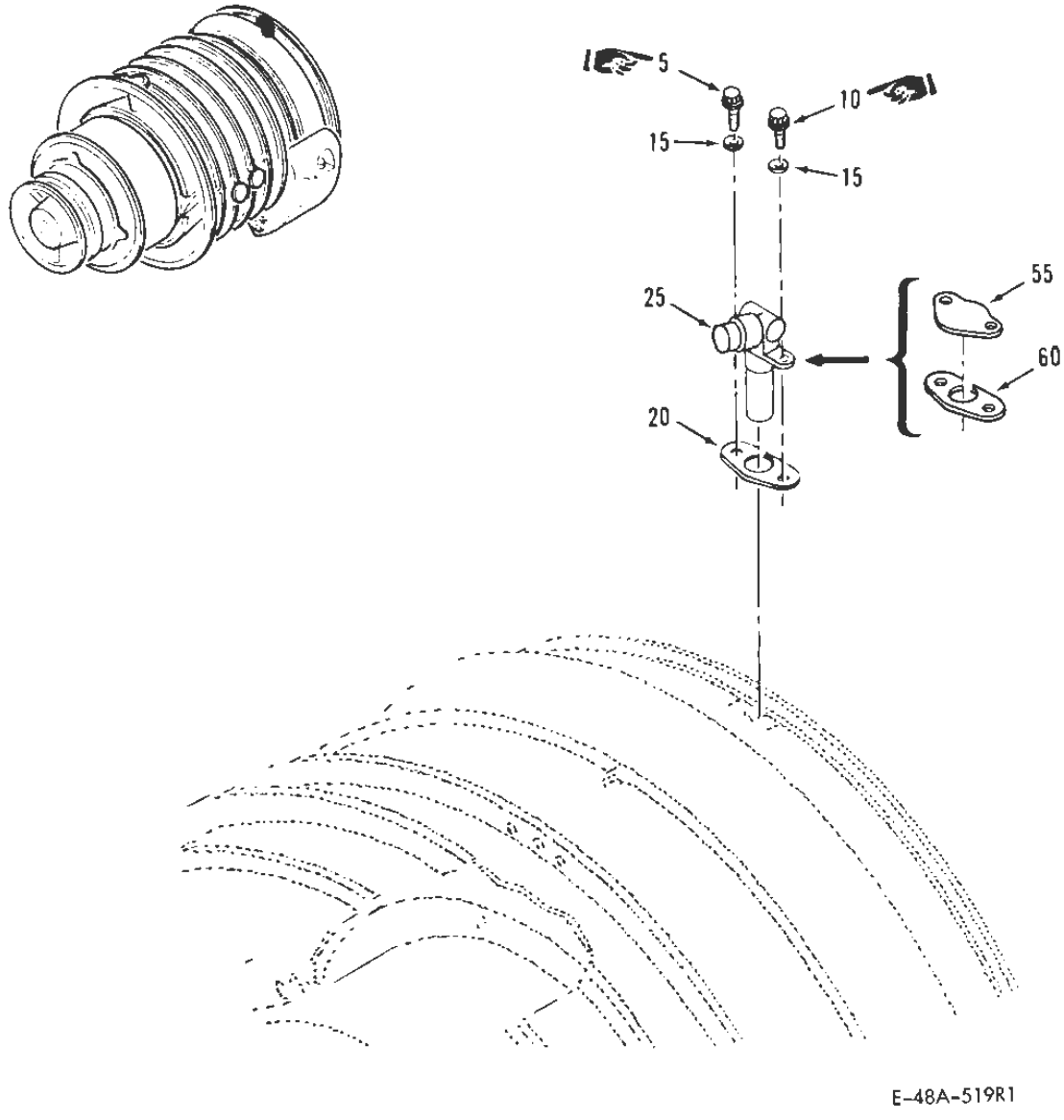
(2) (Code C) Position sensor gasket and plate on engine and secure with bolts and washers.

(3) (Code C) Install sensor and sensor gasket in accordance with Aircraft Maintenance Manual.

(4) Tighten bolts (5, 10) to torque of 40 inch-pounds.

(5) Connect pneumatic tube to pneumatic port on sensor in accordance with Aircraft Maintenance Manual.

(6) (Code A) Install engine wiring harness electrical connector on sensor. Tighten electrical connector using appropriate strap wrench (TG65-1 through TG65-7) (available from Glenair Inc, 1211 Air Way, Glendale, CA 91201). Tighten connector to torque of 70 to 75 inch-pounds.



5. BOLT (IPC FIG. 33)
10. BOLT
15. WASHER
20. SENSOR GASKET
25. INLET PRESSURE AND TEMPERATURE SENSOR
55. PLATE (CODE C)
60. SENSOR (CODE C)

Inlet Pressure and Temperature
Sensor Installation
Figure 201

2. Inspection/Check

A. Inspect Inlet Pressure and Temperature Sensor

(1) Inspect pneumatic fitting threads for visible damage.

(2) Inspect electrical connector for visible damage.

(3) Inspect probe for visible damage.

(4) Visually check temperature sensor through slot on downstream side of probe. If any foreign matter is present, clean sensor in accordance with 3, Cleaning/Painting.

(5) Replace sensor if it does not meet inspection requirements of steps (1) through (3).

B. Check Inlet Pressure and Temperature Sensor Temperature Sensing Element

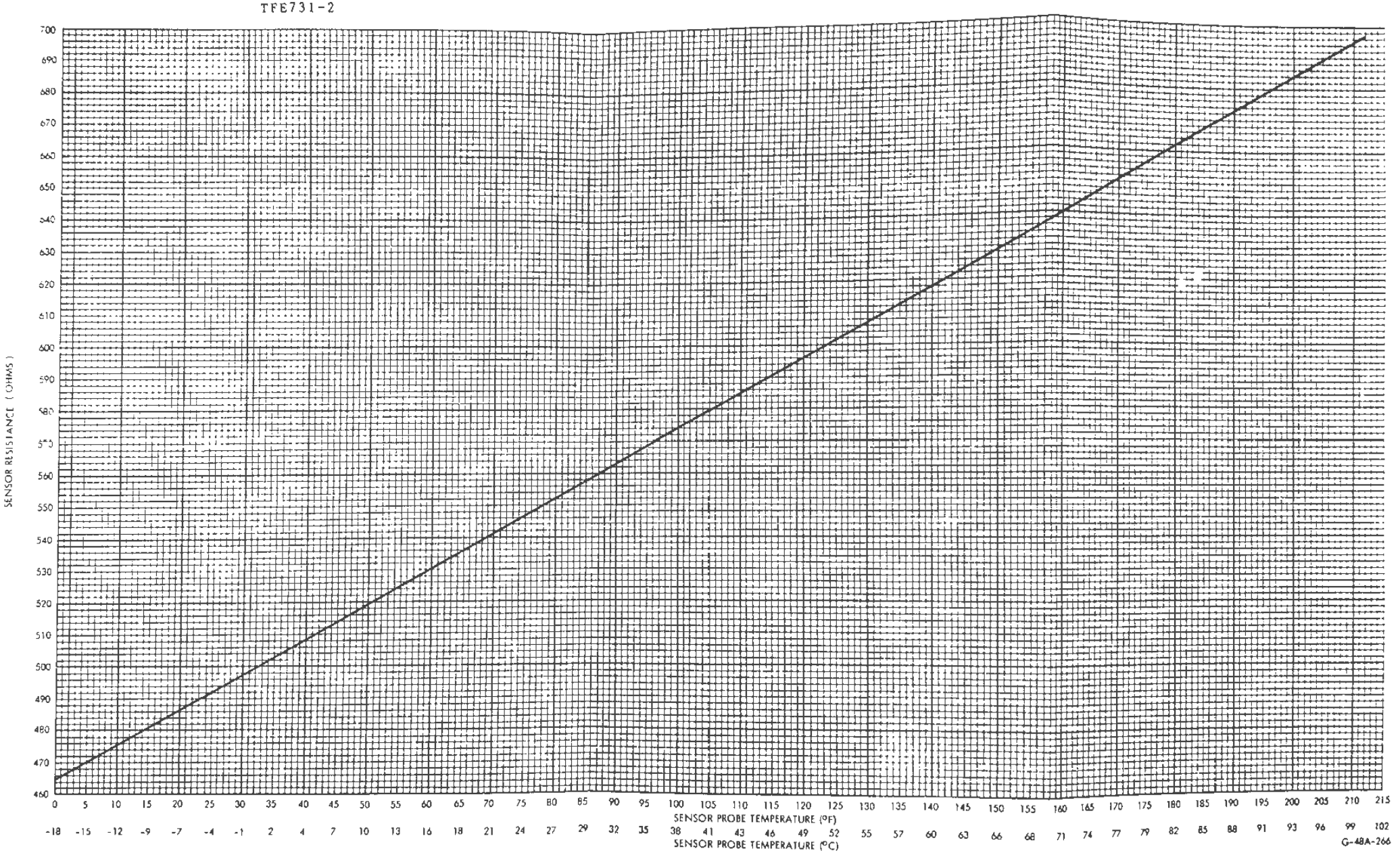
(1) Measure resistance of temperature sensing element across pins A and B of sensor electrical connector. Resistance shall be approximately 465 ohms, plus 1.1 ohms X ambient (sensor probe) temperature in degrees F. (See figure 202.)

NOTE: Sensor temperature sensing element is a highly precise instrument. Use a Wheatstone bridge or similar equipment with a narrow tolerance band and ensure test equipment accuracy before rejecting sensor. Sensor failure normally would not result in a resistance shift but would be evident as an open circuit.

C. Check Inlet Pressure and Temperature Sensor Heater

(1) Measure heater resistance across pins C and D of sensor electrical connector. Resistance shall be 8 $\pm$2 ohms at ambient temperature of 21 $\pm$11C (70 $\pm$20F).

(2) Connect 28 volt dc power source across pins C and D of sensor electrical connector. Sensor probe shall become warm as noted by placing bare hand near probe.



Inlet Pressure and Temperature Sensor
Resistance/Temperature Curve
Figure 202

3. Cleaning/Painting

A. Clean Parts

(1) Clean bolts and washers in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Methods 1 and 2.

(2) Clean inlet pressure and temperature sensor as follows.

(a) Remove any foreign material lodged in internal ports of sensor by blowing compressed air through
R air auxiliary and exit ports at sides of air inlet scoop and at rear of probe. (See figure 203.)

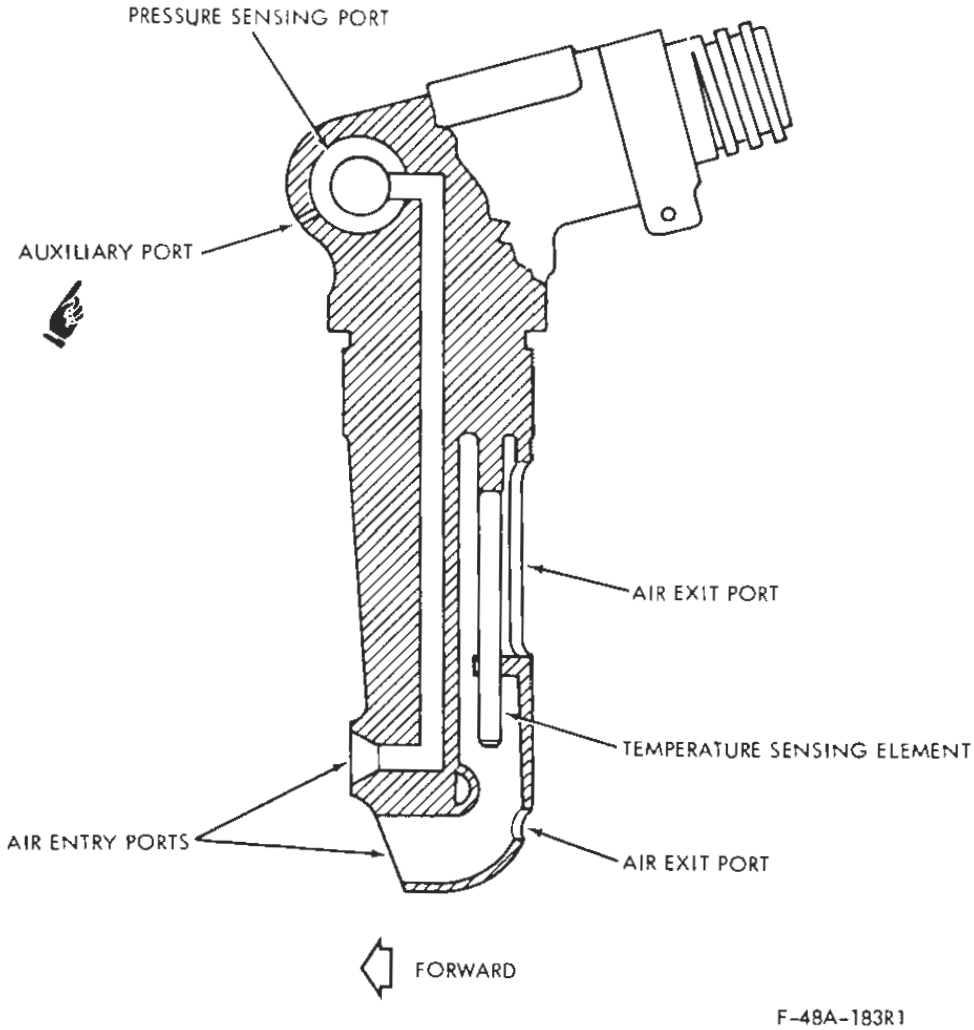
(b) If necessary to clean internal ports of sensor, use syringe to flush internal ports with solution of water and household detergent. After flushing, rinse sensor with clean tap water, then dry with clean compressed air.

(c) If further cleaning is required, soak sensor probe in solution of tap water and household detergent. Move sensor back and forth in liquid, completely flushing internal ports. Rinse sensor under tap water, then dry with clean compressed air.

CAUTION: USE CARE NOT TO DAMAGE INTERNAL TEMPERATURE SENSING ELEMENT OF SENSOR. DO NOT INSERT WIRE OR OTHER DEVICE IN PORTS UNLESS METHODS OF STEPS (b) AND (c) FAIL TO REMOVE CONTAMINATION.

(d) If still further cleaning is required to clean
R foreign material from air auxiliary and exit ports at sides and rear of probe, and adjacent to pressure sensing port, insert 0.020 inch diameter wire in air exit ports to dislodge material. Repeat step (b) after clearing ports.

(e) Clean electrical connector in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method 11.



Inlet Pressure and Temperature
Sensor Cross Section
Figure 203

LIST OF EFFECTIVE PAGES
72-00-72

CHAPTER/ SECTION	PAGE	DATE
List of Effective Pages		Apr 30/80
Record of Temporary Revisions		June 29/79
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	203	Apr 30/80
	204	Apr 30/80
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	206	Apr 30/80
	207	Apr 30/80
	208	Apr 30/80
	209	Apr 30/80
	210	Apr 30/80
	210A	Apr 30/80
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	208	Blank
	209 FO	June 29/79
	210	Blank
	211 FO	June 29/79
	212	Blank
	213	June 29/79
	214	Blank

RECORD OF TEMPORARY REVISIONS

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CHAPTER 76 - ENGINE CONTROLS

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GENERAL - DESCRIPTION AND OPERATION

1. Engine Controls

The engine is equipped with an automatic control system and is provided with a manual backup system. A remotely located electronic computer senses the demands of the engine and inlet air pressure and temperature to maintain proper engine operation. This system consists of the electronic computer, a solenoid controller valve (solenoid controller), and a modulating and shutoff (surge bleed) valve.

The electronic computer performs governing, limiting and scheduling functions in response to engine inputs and flight conditions.

(Code A) An electrical harness is provided to electrically interconnect the electronic computer.

The solenoid controller consists of three bleed-off type solenoid valves. Two of the solenoid valves (solenoids A and B) control the operation of the surge bleed valve.

R (Code C) (Codes A, B Pre SB72-3085) The third solenoid valve (solenoid C) controls operation of the anti-ice valve.

R (Codes A, B Post SB72-3085) The third solenoid valve (solenoid
R C) is plugged.

The surge bleed valve bleeds fourth stage low pressure compressor air to relieve pressure on command from the computer. The valve is normally open and is positioned either fully-closed, one-third open, or fully-open, depending on the position of the two solenoid valves on the solenoid controller. The valve is positioned fully-open with the engine shutdown.

POWER CONTROL - DESCRIPTION AND OPERATION

1. General

The computer portion of the fuel control system is an electronic control that performs governing, limiting, and scheduling functions in response to pilot and engine inputs and flight conditions. The computer requires an electrical input of 15 to 32 volts dc during all modes of engine operation.

The computer provides an appropriate output current to the torque motor of the hydromechanical fuel control based on input signals from the engine power lever position, engine inlet total pressure and temperature, high and low pressure rotor speeds, and control bleed valve areas. The computer includes an output signal for a cockpit-mounted indicator to show manual mode operations in the event of loss of input power, computer malfunction, or pilot deactivation of the computer power by activation of the manual mode switch. The computer is mounted separately from the engine on the airframe.

(Codes A, B Pre SB76-3007) No overspeed protection is supplied by electronic computer during manual (computer off) mode operation.

(Post SB76-3007) Overspeed protection circuits of the electronic computer for both low and high pressure spools remain activated in the manual mode provided the cockpit switch for computer activation is on, and the NORMAL/MANUAL switch on the face of the electronic computer is set to MANUAL (assuming N1 and N2 transducer inputs are available to the computer).

(Codes A, B Pre SB76-3007) When commanded by an aircraft fuel enrichment switch, the electronic computer increases fuel scheduling to assist engine starting. Caution must be exercised not to exceed allowable temperature limits when using this function.

(Post SB76-3007) The electronic computer automatically provides increased fuel scheduling during engine starts to assist starting. When commanded by an aircraft fuel enrichment switch, the electronic computer maintains increased fuel scheduling beyond the turbine temperature limit of automatic fuel enrichment cutoff to assist engine starting. Caution must be exercised not to exceed allowable temperature limits when using this function.

(Code A) The wiring harness is furnished with the engine and consists of connectors and electrical wiring interconnecting electrically operated aircraft and engine components, engine indicating systems and the electronic computer.

(Codes B, C) Electrical interconnection of the electronic computer with engine and aircraft electrically operated components is provided by aircraft wiring.

SURGE BLEED VALVE INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
High temperature compound (Fel-Pro C5-A)	Fel-Pro Inc, Div of Felt Products Mfg Co, 7450 N McCormick Blvd, Skokie, IL 60076
Lubricating compound (Liqui-Moly, Grade NV, thread compound)	Lockrey Co, Lubricants Div, Cedar Shores, Southampton, NY 11968

R A. Remove and Install Solenoid Controller Valve

R (1) Remove solenoid controller valve as follows. (See
R figure 201 or 202.)

(a) Disconnect wiring harness from valve (solenoid controller).

R (b) (Code C) (Codes A, B Pre SB72-3085) Remove anti-ice pressure switch in accordance with 75-10-01, MAINTENANCE PRACTICES.

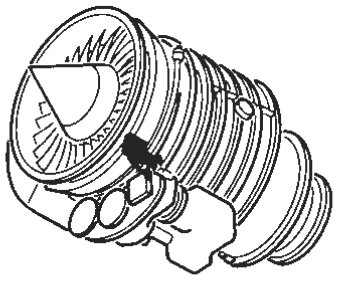
(c) (Code C) Remove clamp, bracket, and attaching hardware used to secure tube assembly connected to solenoid controller port A.

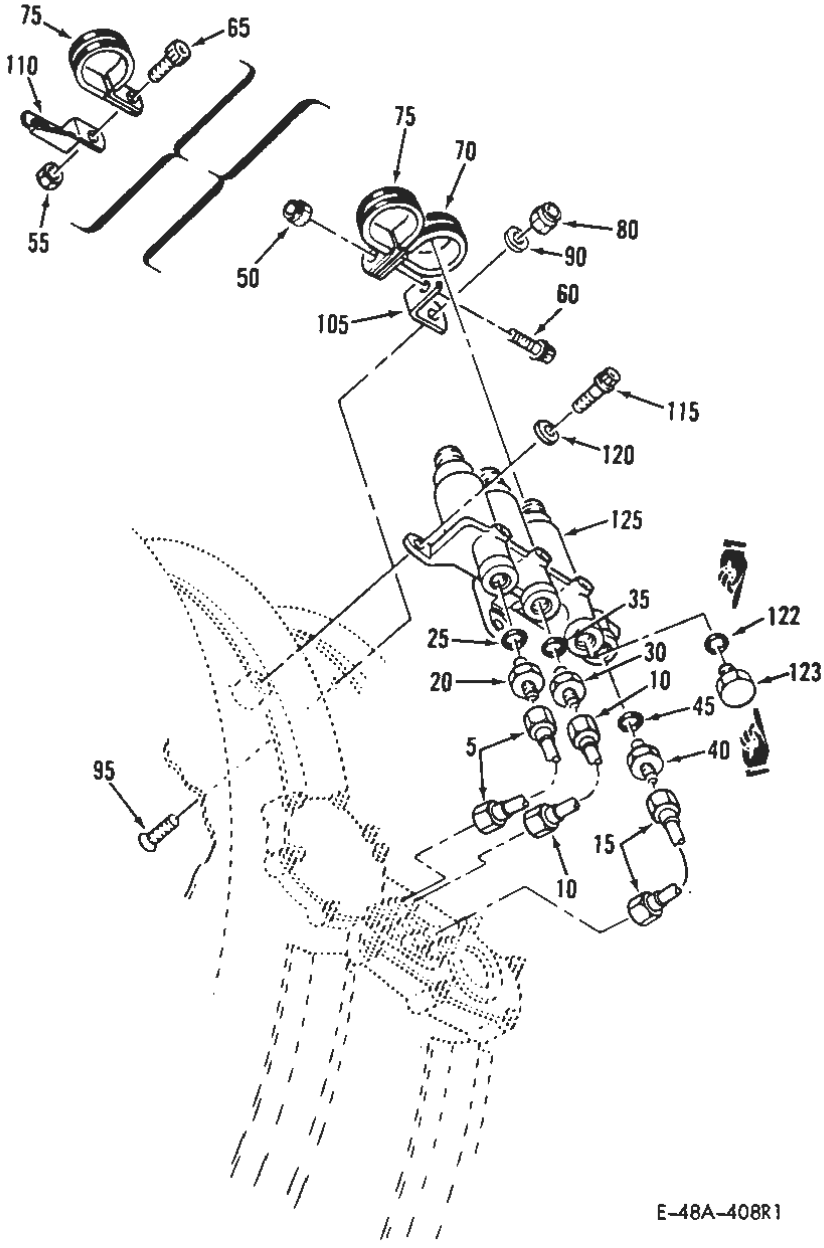
(d) Remove tube assemblies, reducer, unions, and packings connected at ports of solenoid controller.

R (e) (Codes A, B Post SB72-3085) Remove plug and packR ing from solenoid controller.

(f) (Codes A, B) Remove nuts, bolts, screw, washer, and bracket securing clamp or clamps installed on solenoid valve assemblies of solenoid controller. Remove clamp or clamps.

(g) (Codes A, B) Remove bolts and washers securing solenoid controller, then remove solenoid controller.





5.	CONTROLLER PORT B TUBE ASSY (IPC FIG. 38)	50.	NUT (PART DELETED)	95.	SCREW
10.	CONTROLLER PORT A TUBE ASSY	55.	NUT (PART ADDED)	105.	BRACKET (PART DELETED)
15.	CONTROLLER SUPPLY AIR TUBE ASSY	60.	BOLT (PART DELETED)	110.	BRACKET (PART ADDED)
R 20.	REDUCER	65.	BOLT (PART ADDED)	115.	BOLT
R 25.	PACKING	70.	CLAMP (PART DELETED)	120.	WASHER
R 30.	UNION	75.	CLAMP	122.	PACKING (CODES A, B POST SB72-3085)
R 35.	PACKING	80.	NUT	123.	PLUG (CODES A, B POST SB72-3085)
40.	UNION	90.	WASHER	125.	VALVE (SOLENOID CONTROLLER)
45.	PACKING				

(Codes A, B) Solenoid Controller Valve
Figure 201

1. A. (1) (h) (Code C) Remove nuts, bolts, and washers securing solenoid controller to solenoid bracket, then remove solenoid controller.

(i) (Code C) Remove nuts, bolts, and washers securing solenoid brackets, then remove solenoid brackets.

R (2) Install solenoid controller valve as follows. (See
R figure 201 or 202.)

R NOTE: Refer to 70-00-00, STANDARD PRACTICES
R for general torque values. Add fric-
R tional drag (run-down) torque of self-
R locking devices to recommended values.

R (a) Install new packing on unions and reducer for
R solenoid controller, then install unions and
R reducer.

R (b) (Codes A, B Post SB72-3085) Install new packings
R on plug, then install plug.

R (c) (Codes A, B) On engines incorporating bracket
R (105, figure 201), install components as follows.

R 1) Install clamps on two forward solenoid valve
R assemblies of solenoid controller.

R 2) Coat threads of screw for securing bracket
R (105) with lubricating compound (Liqui-Moly,
R Grade NV, thread compound). Install bracket
R (105) with nut, washer, and screw.

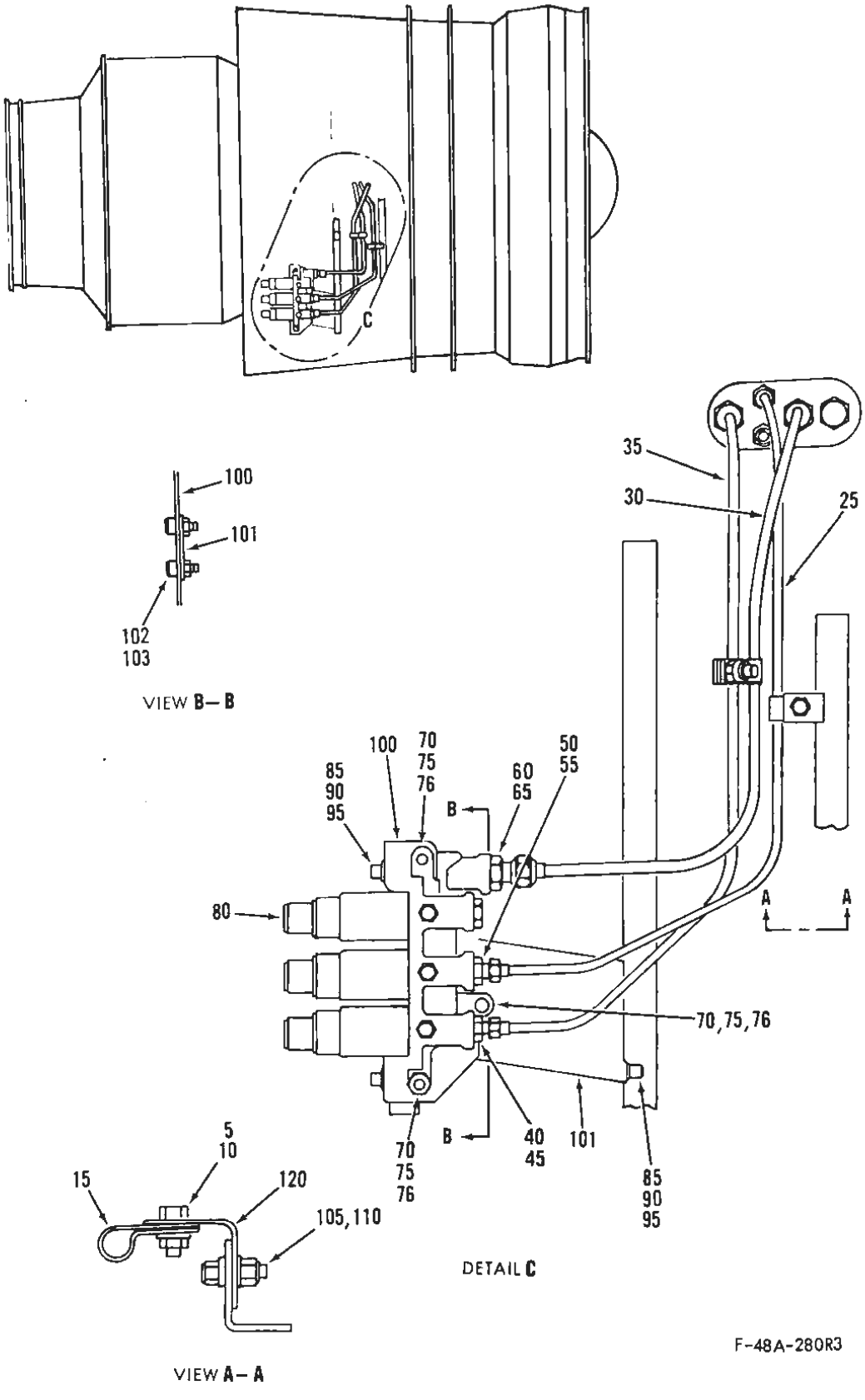
R 3) Tighten screw (95) to torque of 30 inch-
R pounds.

R (d) (Codes A, B) On engines incorporating bracket
R (110, figure 201), install components as follows.

R 1) Install clamp on forward solenoid valve assem-
R bly of solenoid controller.

R 2) Coat threads of screw for securing bracket
R with lubricating compound (Liqui-Moly, Grade
R NV, thread compound). Install bracket (110)
R with nut, washer, and screw.

R 3) Tighten screw (95) to torque of 30 inch-
R pounds.



(Code C) Solenoid Controller Valve
Figure 202

R

R 1. A. (2) (e) (Code C) Apply a light coat of lubricating compound (Liqui-Moly, Grade NV, thread compound) to threads of bolts for brackets. Install solenoid brackets with nuts, washers, and bolts. Tighten bolts (90, 103, figure 202) to torque of 30 inch-pounds. Install bracket to support controller port A tube assembly with nut and bolt. Tighten bolt (110) to torque of 30 inch-pounds.

R (f) Coat threads of bolts for securing solenoid controller with lubricating compound (Liqui-Moly, Grade NV, thread compound).

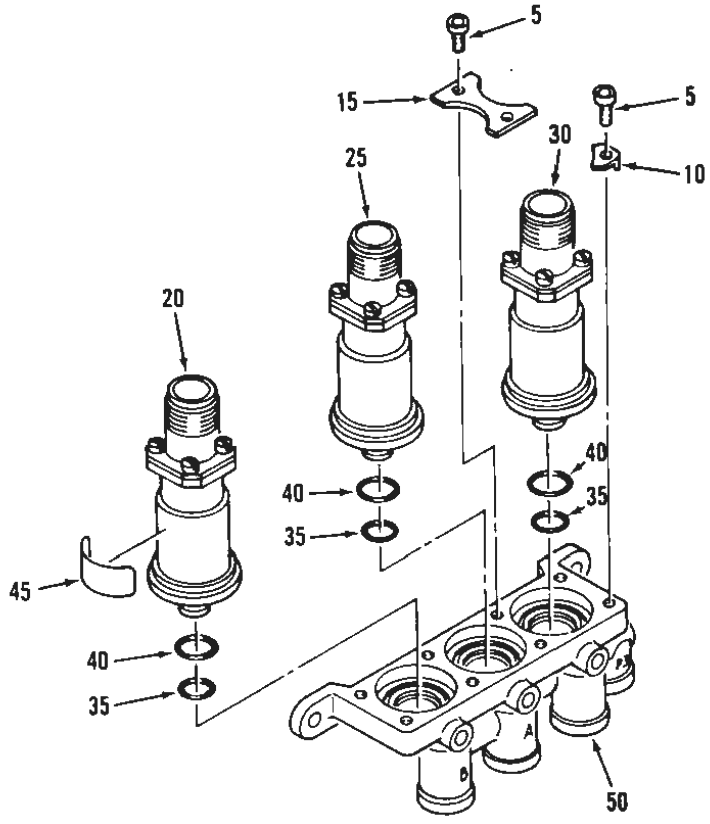
R (g) (Codes A, B) Position solenoid controller on engine and secure with washers and bolts. Tighten bolts (115, figure 201) to torque of 30 inch-pounds.

R (h) (Code C) Position solenoid controller on solenoid bracket and secure with bolts and nuts. Tighten bolts (75, figure 202) to torque of 30 inch-pounds.

R (i) (Codes A, B) Coat threads of bolt for securing clamp or clamps with lubricating compound (Liqui-Moly, Grade NV, thread compound). Secure clamp or clamps installed on solenoid valve assemblies of solenoid controller to adjacent bracket with nut and bolt. Tighten bolt (60 or 65, figure 201) to torque of 30 inch-pounds.

KEY TO FIGURE 202

5.	NUT (IPC FIG. 39)	75.	BOLT
10.	BOLT	76.	WASHER
15.	CLAMP	80.	VALVE (SOLENOID CONTROLLER)
25.	CONTROLLER PORT A TUBE ASSY	85.	NUT
30.	CONTROLLER SUPPORT AIR (P3) TUBE ASSY	90.	BOLT
35.	CONTROLLER PORT B TUBE ASSY	95.	WASHER
40.	REDUCER	100.	SOLENOID BRACKET
45.	PACKING	101.	BRACKET
50.	UNION	102.	NUT
55.	PACKING	103.	BOLT
60.	UNION	110.	BOLT
65.	PACKING	120.	BRACKET
70.	NUT		



R 5. SCREW (IPC FIG. 40)
R 10. RETAINER CLIP
R 15. SOLENOID RETAINER
R 20. SOLENOID VALVE ASSY
R 25. SOLENOID VALVE ASSY
30. SOLENOID VALVE ASSY
35. PACKING
40. PACKING
*45. IDENTIFICATION PLATE
50. BODY ASSY

*NOT REMOVED AT MAINTENANCE LEVEL

Solenoid Controller
Figure 203

R 1. A. (2) (j) Install solenoid controller supply air (P3), port A, and port B tube assemblies.

(k) (Code C) Secure tube assembly for port A of solenoid controller with clamp, nuts, bolts, and bracket. Tighten bolts (10, 110, figure 202) to torque of 30 inch-pounds.

(l) (Code C) (Codes A, B Pre SB72-3085) Install anti-ice pressure switch in accordance with 75-10-01, MAINTENANCE PRACTICES.

(m) (Code A) Connect engine wiring harness connectors P16 and P17 to solenoid valve connectors J16 and J17 on solenoid controller. Tighten P16 and P17 to 26 to 32 inch-pounds torque using TG67-1 through TG65-7 strap wrenches (Glenair Inc, 1211 Air Way, Glendale, CA 92101).

B. Disassemble and Assemble Solenoid Controller

(1) Disassemble solenoid controller as follows. (See figure 203.)

(a) Tag each solenoid valve assembly with location on body assembly to ensure proper location at reassembly.

(b) Remove screws, retainer clips, and solenoid retainers securing solenoid valve assemblies to body assembly.

(c) Remove solenoid valve assemblies. Remove packings from solenoid valve assemblies.

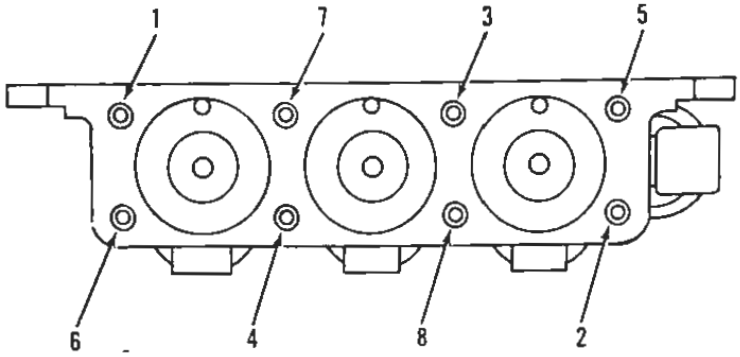
(2) Assemble solenoid controller as follows. (See figure 203.)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(a) Install new packings on each solenoid valve assembly.

(b) Install solenoid valve assemblies into body assembly in locations noted at disassembly. Orient each solenoid valve assembly so key on electrical connector is in line with and pointing toward small boss on body assembly at base of each solenoid valve assembly.

R 1. B. (2) (c) Install solenoid retainers, retainer clips, and screws to secure solenoid valve assemblies. Tighten screws (5) to torque of 12 to 15 inch-pounds using the sequence shown in Figure 204.



Solenoid Controller Screw Tightening Sequence
R Figure 204

R C. Remove and Install Surge Bleed Valve

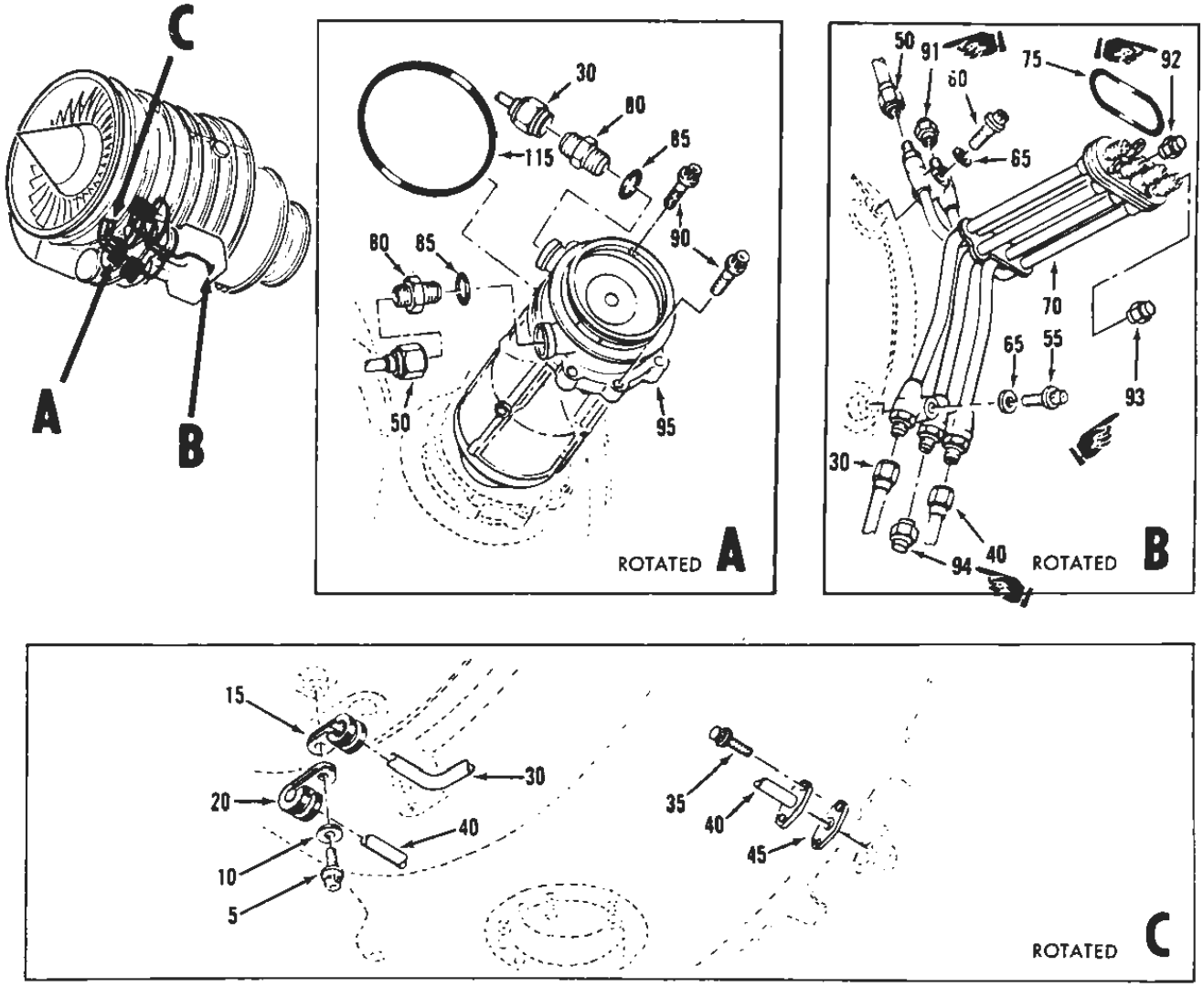
R (1) Remove surge bleed valve as follows. (See figure 205.)

R (a) Remove right side bleed air port cover, gasket and outer flange, then rotate low pressure bleed air duct 90 degrees in accordance with 75-10-05, MAINTENANCE PRACTICES.

R (b) Remove right side bypass duct panel and panel fairing in accordance with 79-20-09, MAINTENANCE PRACTICES.

R (c) Disconnect input A and input B tube assemblies at surge bleed valve.

R (d) Remove bolts securing surge bleed valve. Remove surge bleed valve, then remove unions and packings from surge bleed valve.



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	5.	BOLT (IPC	45.	GASKET		90.	BOLT
R		FIG. 42)	50.	INPUT A TUBE	*	91.	CAP
R	10.	WASHER		ASSY	**	92.	CAP
R	15.	CLAMP	55.	BOLT	**	93.	CAP
R	20.	CLAMP	60.	BOLT	*	94.	CAP
	30.	INPUT B TUBE	65.	WASHER		95.	PNEUMATIC MOD-
		ASSY	70.	MANIFOLD			ULATING AND
	35.	BOLT	75.	PACKING			SHUTOFF (SURGE
	40.	P3 SUPPLY TUBE	80.	UNION			BLEED) VALVE
		ASSY	85.	PACKING		115.	PACKING

R *(POST SB72-3085) (PART ADDED)
R **(CODES A, B POST SB72-3085)

Surge Bleed Valve and Anti-Ice
Components Installation
Figure 205

R 1. C. (2) Install surge bleed valve as follows. (See figure
R 205.)

R NOTE: Refer to 70-00-00, STANDARD PRACTICES
R for general torque values. Add fric-
R tional drag (run-down) torque of self-
R locking devices to recommended values.

R (a) Install new packings on unions for surge bleed
R valve and on surge bleed valve. Install unions.
R Coat threads of bolts for securing surge bleed
R valve with lubricating compound (Liqui-Moly, Grade
R NV, thread compound). Position surge bleed valve
R on engine and secure with bolts. Tighten bolts
R (90) to torque of 50 inch-pounds.

R (b) Connect input A and input B tube assemblies at
R surge bleed valve.

R (c) Install right side bypass duct panel fairing and
R panel in accordance with 79-20-09, MAINTENANCE
R PRACTICES.

R (d) Rotate right side low pressure bleed air duct 90
R degrees, then install bleed air port outer flange,
R gasket, and cover in accordance with 75-10-05,
R MAINTENANCE PRACTICES.

R 1. D. Remove and Install Air Line Manifold Installation

R (1) Remove air line manifold installation as follows. (See R figure 205.)

R (a) (Code A) Remove engine wiring harness in accord- R ance with 72-00-02, MAINTENANCE PRACTICES.

R (b) Remove fuel and P3 sensing lines installation in R accordance with 73-10-02, MAINTENANCE PRACTICES.

R (c) Remove ignition unit and remove lockplate and R grommet securing igniter leads in accordance with R 74-00-01, MAINTENANCE PRACTICES.

R (d) (Code C) (Codes A, B Pre SB72-3085) Remove pneu- R matic tube to anti-ice pressure switch, pressure R switch, and tube to solenoid controller valve in R accordance with 75-10-01, MAINTENANCE PRACTICES.

R (e) Remove solenoid controller valve and attached R tubes in accordance with step A.(1).

R (f) (Codes A, B Pre SB72-3040) Remove fan duct assem- R bly in accordance with 72-70-05, MAINTENANCE R PRACTICES.

R (g) (Code C) (Codes A, B Post SB72-3040) Remove upper R half of fan duct set in accordance with 72-70-05, R MAINTENANCE PRACTICES.

R (h) Remove oil-out elbow assembly connected to right R side duct in accordance with 79-20-07, MAINTENANCE R PRACTICES.

R (i) Remove oil transfer tube connected to left side R fairing in accordance with 79-20-06, MAINTENANCE R PRACTICES.

R (j) Remove right side duct, left side fairing oil-in R and oil-out tubes, side and bottom panels and up- R per and lower surface oil (air/oil) coolers in ac- R cordance with 79-20-09, MAINTENANCE PRACTICES.

R (k) Remove bolt and washer securing clamps on input B R and P3 supply tube assemblies. Remove clamps.

R (l) Remove bolts securing P3 supply tube assembly to R engine. Remove P3 supply tube assembly and mating R gasket.

R (m) Remove input A and input B tube assemblies.

R 1. D. (1) (n) Remove bolts and washers securing manifold to engine. Remove manifold, then remove caps and packings from manifold.

(2) Install air line manifold installation as follows. (See figure 205.)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(a) Install caps and new packing on manifold and position manifold on engine. Apply light coat of lubricating compound (Liqui-Moly, Grade NV, thread compound) to threads of bolts securing manifold and secure manifold with bolts and washers. Tighten bolts (55, 60) to torque of 25 inch-pounds.

(b) Coat threads of bolts used to secure P3 supply air line to plenum case with high temperature compound (Fel-Pro C5-A). Install new gasket on P3 supply air line. Install P3 supply air line and secure with bolts. Tighten bolts (35) to torque of 40 inch-pounds.

(c) Install input A and input B tube assemblies. Install clamps on input B and P3 supply tube assemblies. Install clamps on input B and P3 supply tube assemblies and secure with bolt and washer. Tighten bolt (5) to torque of 40 inch-pounds.

(d) Install upper and lower surface oil (air/oil) coolers, side and bottom panels, oil-in and oil-out tubes, right side duct, and left side fairing in accordance with 79-20-09, MAINTENANCE PRACTICES.

(e) Install oil transfer tube on left side fairing in accordance with 79-20-06, MAINTENANCE PRACTICES.

(f) Install oil-out elbow assembly on right side duct in accordance with 79-20-07, MAINTENANCE PRACTICES.

(g) (Codes A, B Pre SB72-3040) Install fan duct assembly in accordance with 72-70-05, MAINTENANCE PRACTICES.

R 1. D. (2) (h) (Code C) (Codes A, B Post SB72-3040) Install upper half of fan duct set in accordance with 72-70-05, MAINTENANCE PRACTICES.

(i) (Code C) (Codes A, B Pre SB72-3085) Install pneumatic tube to anit-ice pressure switch, pressure switch, and tube to solenoid controller valve in accordance with 75-10-01, MAINTENANCE PRACTICES.

(j) Install solenoid controller valve and attached tubes in accordance with step A.(2).

(k) Install lockplate and grommet to secure igniter leads and install ignition unit in accordance with 74-00-01, MAINTENANCE PRACTICES.

(l) Install fuel and P3 sensing lines installation in accordance with 73-10-02, MAINTENANCE PRACTICES.

(m) (Code A) Install engine wiring harness in accordance with 72-00-02, MAINTENANCE PRACTICES.

R 2. Inspection/Check

R A. Inspect Tube Assemblies (See Figures 201, 202, and 205)

(1) Inspect tubes for corrosion, cracked flares, or dents which cause a crease or reduce diameter more than ten percent.

(2) Inspect tubing connections for damaged threads, sleeves, and nuts.

(3) Replace tube assemblies that do not meet inspection requirements of steps (1) and (2).

R B. Inspect Surge Bleed Valve (See Figure 205)

(1) Inspect valve for corrosion, cracks, damage to fitting threads or damage to poppet. Replace valve if any of the listed defects are evident.

(2) Check lockwired round nut securing actuator cover on bottom end of valve with fingers for looseness. If looseness is observed, tighten round nut to 150 to 250 inch-pounds of torque using 289925-1 torque wrench adapter and install new lockwire.

R NOTE: Leak check of step (3) ensures proper functioning of valve. This check may be performed with valve removed or with valve installed on engine when access permits. When valve is installed on engine and access does not permit performing step (3), check function of valve in accordance with step (4).

R 2. B. (3) Manually push poppet closed and close off Port B. Release poppet while maintaining Port B closed. Poppet shall return to fully open position in not less than six seconds.

R (4) Check function of valve (installed on engine) using compressed air when access does not permit performing step (3) as follows.

R (a) Remove tube assembly connected from port labeled B on solenoid controller to fitting on air line manifold (Port B fitting). (See figure 201.) Connect source of clean, dry, compressed air, variable over the range of 0 to 90 psig, to Port B fitting on air line manifold located at right side duct on lower fan duct.

R (b) Remove tube assembly connected from port labeled A on solenoid controller to fitting on air line manifold (Port A fitting). (See figure 201.) Connect 0 to 100 psig pressure gage on Port A fitting on air line manifold located at right side duct on lower fan duct.

R (c) Slowly apply increasing air pressure from compressed air source and observe poppet on surge bleed valve. Poppet shall fully close before pressure at Port B fitting exceeds 14 psig. If requirement is not met, replace surge bleed valve.

R (d) Set compressed air source pressure at Port B fitting to 15 +1/-1 psig and observe pressure gage at Port A fitting. Port A pressure shall not exceed 1.5 psig. If requirement is not met, replace surge bleed valve.

R (e) Set compressed air source pressure at Port B fitting to 84 +1/-1 psig and observe pressure gage at Port A fitting. Port A pressure shall not exceed 15 psig. If requirement is not met, replace surge bleed valve.

R (f) Remove pressure gage and compressed air source from air line manifold fittings and install

previously removed tube assemblies between manifold and solenoid controller valve.

2. C. Inspect Solenoid Controller (See Figure 203)

(1) Inspect electrical connectors on solenoid valve assemblies for damaged pins.

(2) Inspect body assembly and solenoid valve assemblies for corrosions, cracks or damage.

(3) Inspect vent holes on bottom of body assembly for obstruction.

(4) Check resistance of each solenoid valve assembly (pin A to pin B). Resistance shall be 35 to 45 ohms in each case.

(5) Replace solenoid controller or individual solenoid valve assemblies which do not meet inspection requirements of steps (1), (2), (3) and (4).

3. Cleaning/Painting

A. Clean Parts

Clean parts as specified in Table 202 in accordance with cleaning methods specified in 72-00-00, GENERAL - CLEANING/PAINTING.

Table 202. Cleaning Methods

Figure No.	Item No.	Nomenclature	Cleaning Method 1	2	3	4	5	6	7	8	9	10	11	12
All standard metallic hardware			X	X										
Plumbing and fittings														X
205	70	Manifold												X

ELECTRONIC COMPUTER AND COMPUTER HARNESS - MAINTENANCE PRACTICES

1. Removal/Installation

   A. Remove and Install Electronic Computer and Computer Harness (See Figure 201)

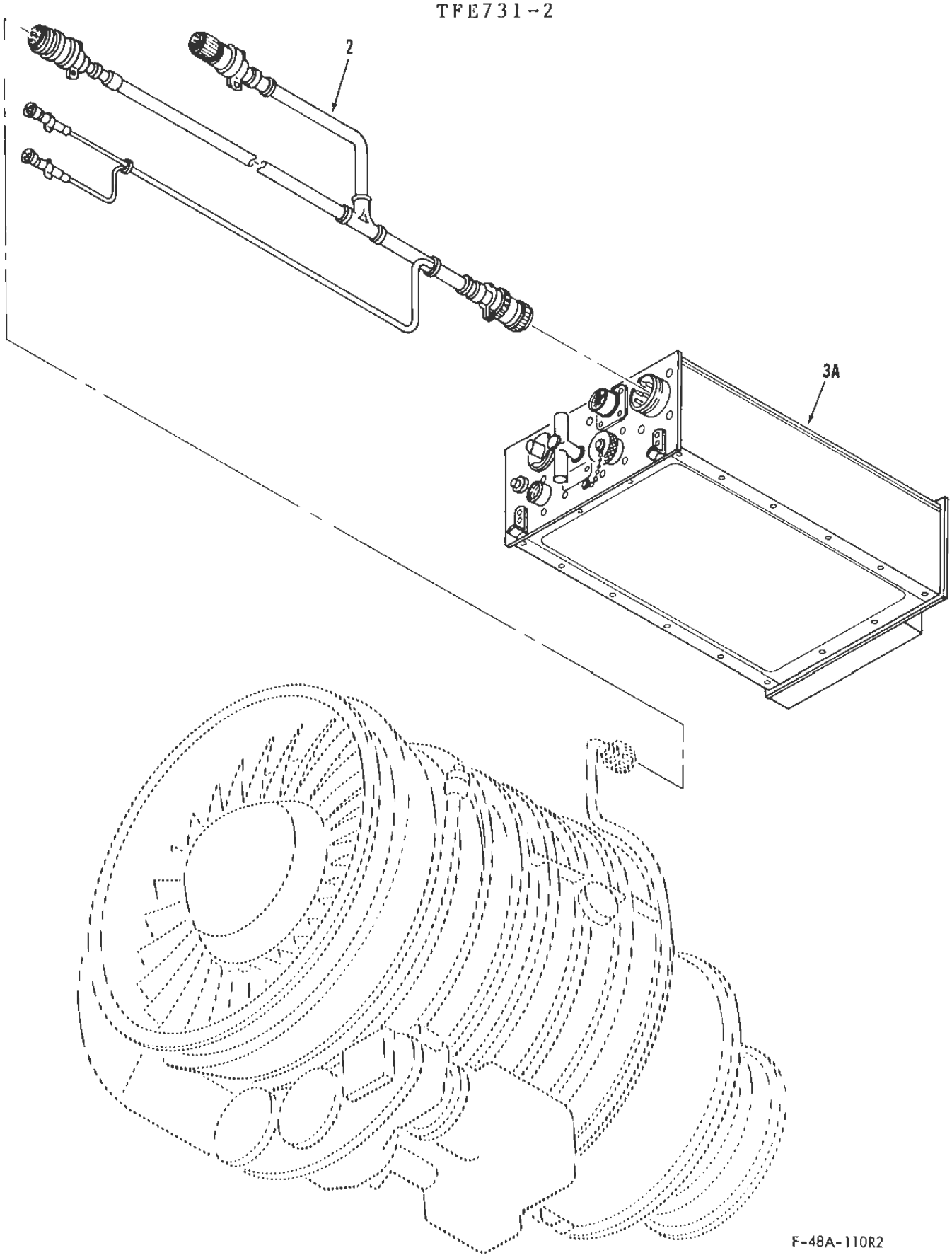
      CAUTION: AN INTERNAL BELLOWS OF THE ELECTRONIC COMPUTER MAY BE DAMAGED IF AIRCRAFT PNEUMATIC FITTING (FOR INLET PRESSURE CONNECTION ON ELECTRONIC COMPUTER FRONT FACE) IS THREADED TOO FAR INTO PORT. FITTING DEPTH INTO PORT SHALL NOT EXCEED 0.538 INCH. ENSURE JAM NUT IS THREADED OUT FAR ENOUGH TO PROPERLY POSITION O-RING TYPE PACKING FOR FITTING. TIGHTEN JAM NUT TO TORQUE OF 30 INCH-POUNDS.

      NOTE: When a new or replacement electronic computer is installed, ensure proper adjustment in accordance with 72-00-00, GENERAL - ADJUSTMENT/TEST, paragraph 7.

      (1) The Removal/Installation instructions for the electronic computer and the computer harness are contained in the Aircraft Maintenance manual.

      (2) After installation of electronic computer on aircraft in accordance with Aircraft Maintenance Manual, ensure proper adjustment in accordance with 72-00-00, GENERAL - ADJUSTMENT/TEST, paragraph 7.

      (3) (Code A) Comply with the following general installation instructions and torque values for electrical connectors.



2. COMPUTER WIRING HARNESS ASSY

3A. ELECTRONIC COMPUTER

Electronic Computer and Computer Harness Assembly
Figure 201

CAUTION: THE MALE THREADED PORTION OF FIREWALL CONNECTORS MATING WITH CONNECTORS P1 and P5 SHALL BE HELD FIRMLY TO PREVENT ROTATION WHEN MATING CONNECTOR IS TIGHTENED.

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

1. (A) (3) (a) Tighten computer wiring harness assembly electrical connector using TG65-1 through TG65-7 strap wrenches (Glenair Inc, 1211 Air Way, Glendale, CA 91201). Tighten connectors to the following torques: P1, P5 - 70 to 75 inch-pounds; P13 - 90 to 95 inch-pounds; P11 - 100 to 110 inch-pounds.

(b) Apply lockwire to electrical connectors in accordance with good shop practices, ensuring lockwire is tight and installed to prevent any loosening rotation. Aerospace Standard AS567 (SAE) may be used as a guide for lockwire installation.

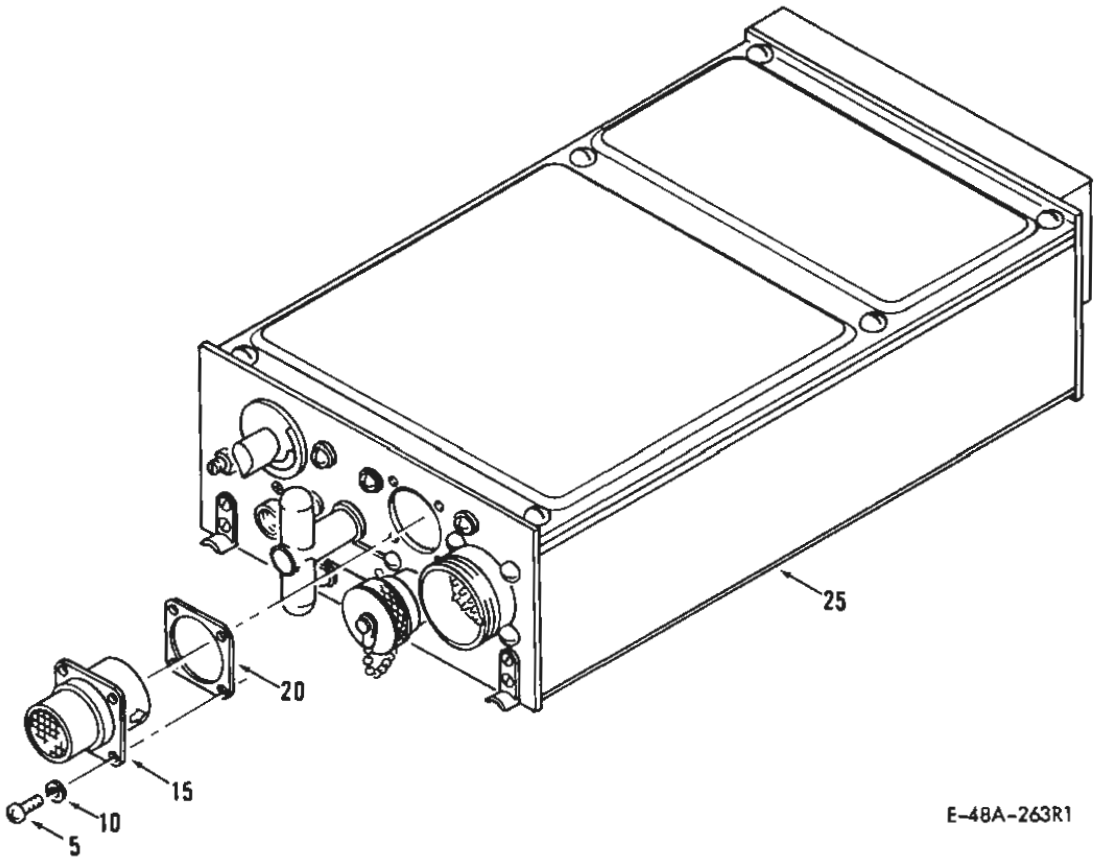
B. Remove Electronic Computer Air Filter (See Figure 202)

(1) Remove screws, washers, air filter and gasket.

C. Install Electronic Computer Air Filter (See Figure 202)

(1) Install gasket and air filter. Secure with screws and washers.

R



R 5. SCREW (IPC FIG. 41)
R 10. WASHER
R 15. AIR FILTER
20. GASKET
25. ELECTRONIC COMPUTER

Electronic Computer
Figure 202

2. Inspection/Check

A. (Code A) Inspect Computer Wiring Harness Assembly

(1) Inspect insulation sleeving for evidence of breaks, burns and deterioration.

(2) Inspect connectors for cracks, corrosion, loose wiring, bent, broken or burned pins and connector threads for damage.

(3) Inspect terminals for security or broken wires.

(4) Check wiring harness assembly for point to point continuity. (See figures 203, 204, and 205.)

(5) (3070854-1, 3070854-2, or 3070933-1 Wiring Harness Assembly) Using multimeter set to highest resistance scale, check resistance from each connector pin to harness shielding. No deflection shall be observed except for pins connected directly to shielding (P11-23, J12-R). If requirements are not met, clean electrical connectors in accordance with 3, Cleaning/Painting and repeat check.

(6) Refer to 4, Approved Repairs if requirements of steps (1) through (5) are not met.

2. B. (Codes B, C) Inspect Computer Wiring Harness Assembly

Electrical interconnection of electronic computer is provided by aircraft wiring. Refer to Aircraft Maintenance Manual.

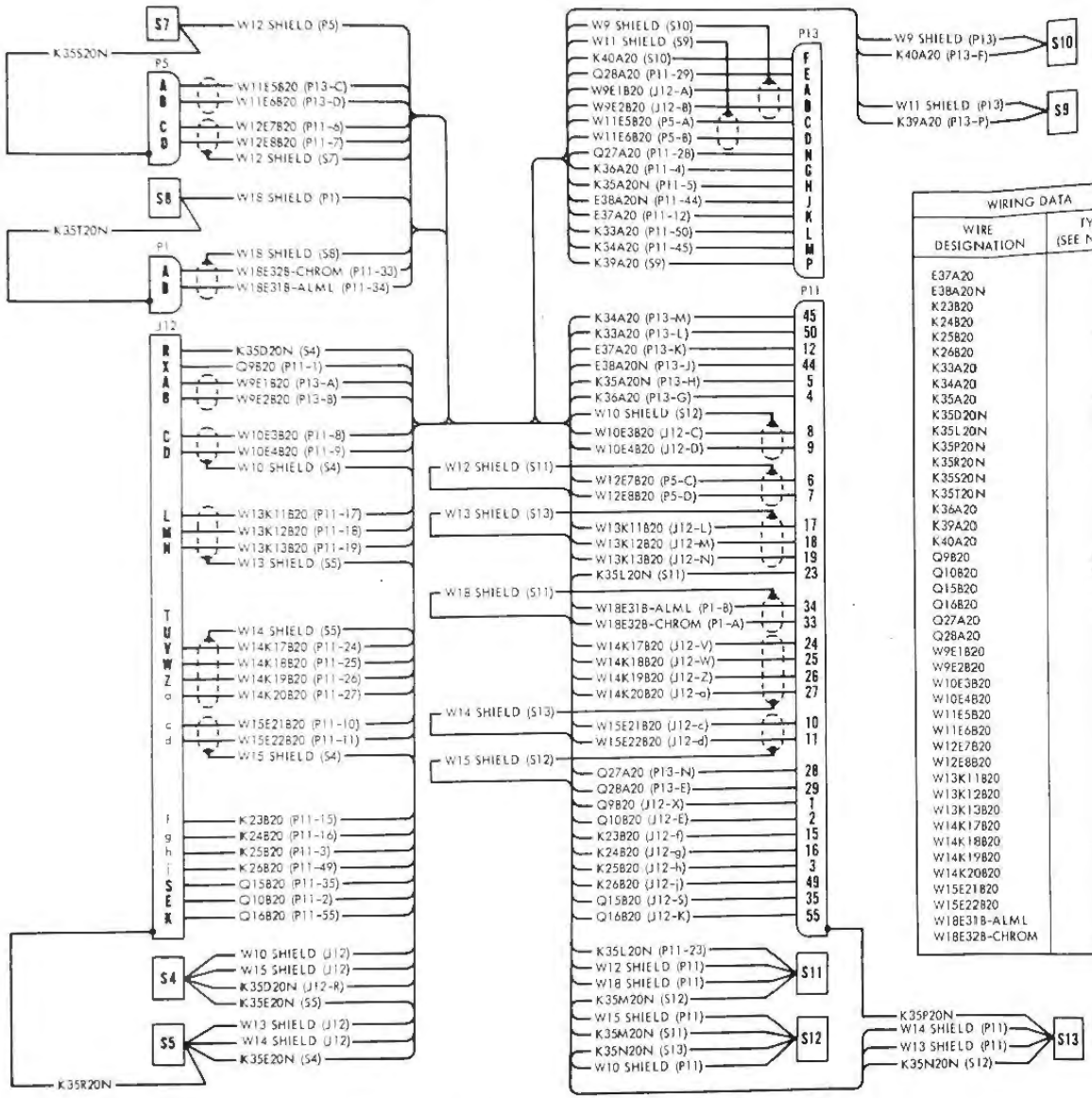
C. Inspect Electronic Computer

(1) Inspect external connectors and fittings for bent or burned pins or damaged threads.

(2) Replace electronic computer if external connectors or fittings have bent or burned pins or damaged threads.

D. Inspect Electronic Computer Air Filter

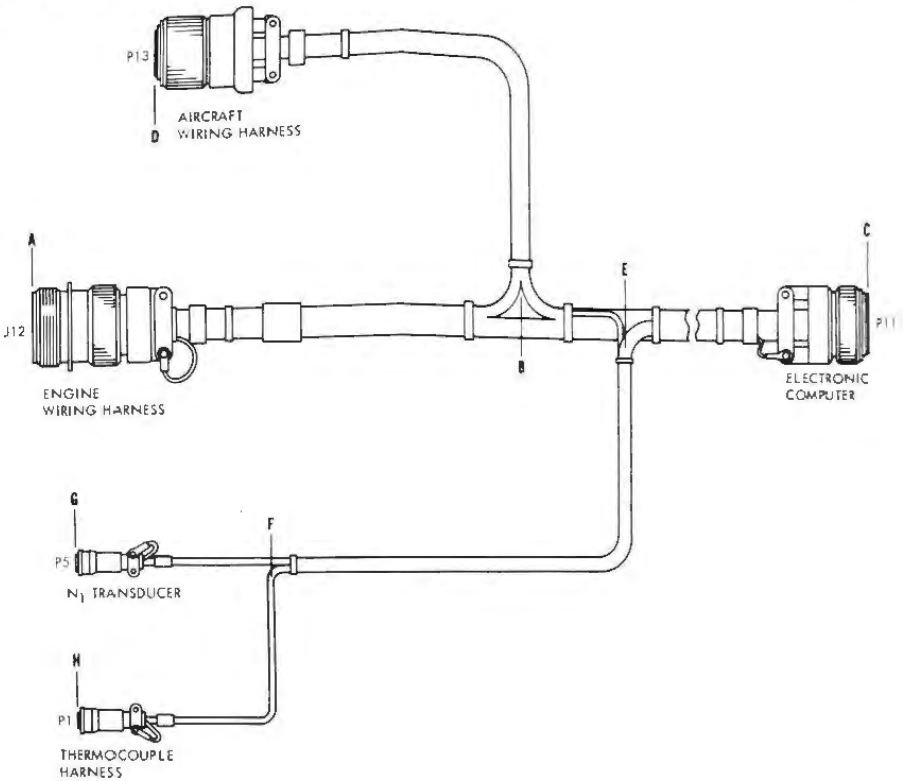
Inspect air filter for any visual damage or clogging. Bake dry or replace air filter if any damage or clogging is evident.



WIRING DATA	
WIRE DESIGNATION	TYPE (SEE NOTES)
E37A20	1
E38A20N	1
K23B20	1
K24B20	1
K25B20	1
K26B20	1
K33A20	1
K34A20	1
K35A20	1
K35D20N	2
K35L20N	2
K35P20N	1
K35R20N	1
K35S20N	1
K35T20N	1
K36A20	1
K39A20	2
K40A20	2
Q9B20	1
Q10B20	1
Q15B20	1
Q16B20	1
Q27A20	1
Q28A20	1
W9E1B20	3
W9E2B20	3
W10E3B20	3
W10E4B20	3
W11E5B20	3
W11E6B20	3
W12E7B20	3
W12E8B20	3
W13K11B20	4
W13K12B20	4
W13K13B20	4
W14K17B20	5
W14K18B20	5
W14K19B20	5
W14K20B20	5
W15E21B20	3
W15E22B20	3
W18E31B-ALML	6
W18E32B-CHROM	6

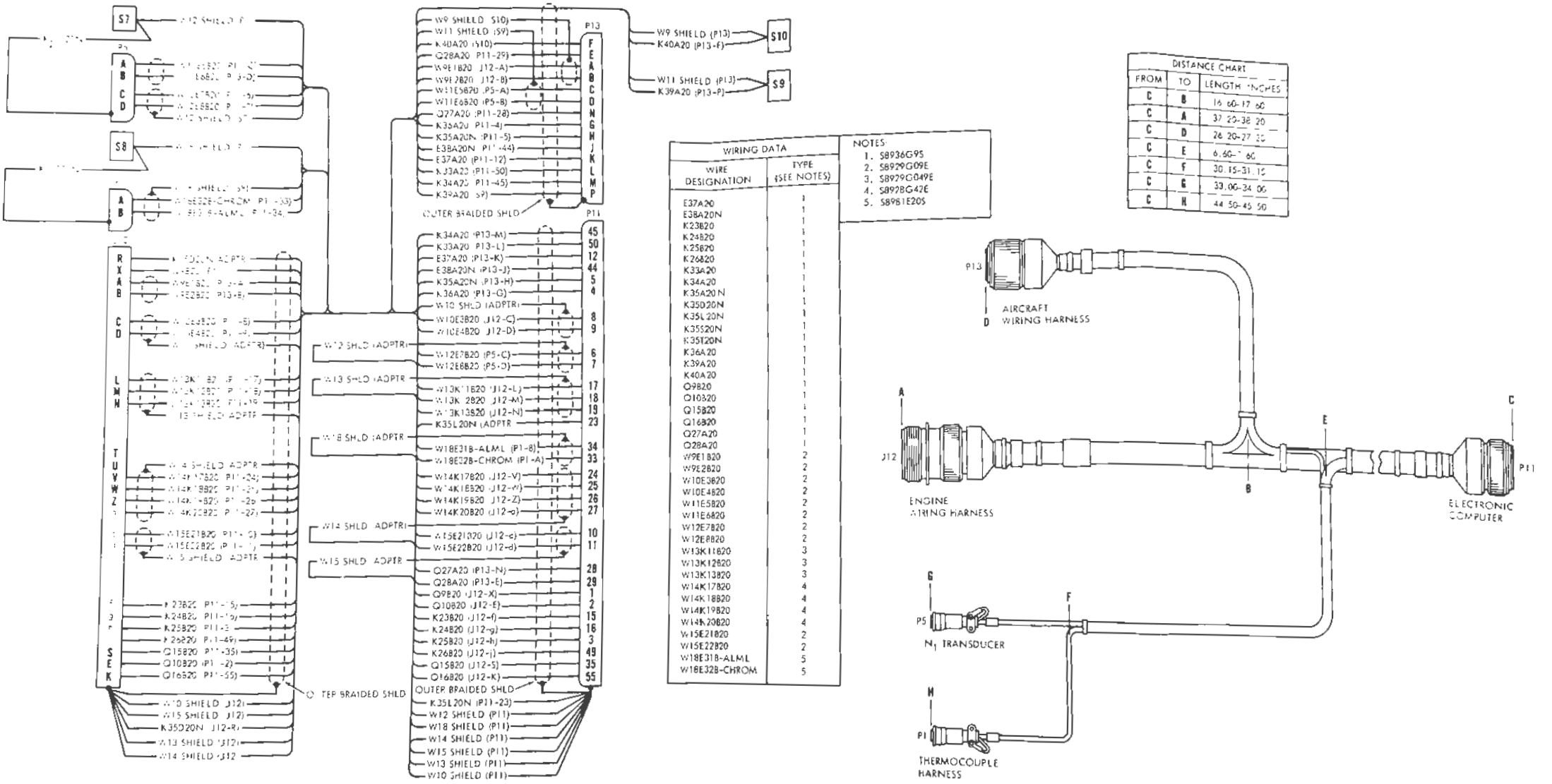
NOTES:
1. MIL-W-22759/5-20-9
2. S893569N
3. S8929G09E
4. S8929G049E
5. S892BG42E
6. S89B1E20S

DISTANCE CHART		
FROM	TO	LENGTH (INCHES)
C	B	16.60-17.60
C	A	37.20-38.20
C	D	26.20-27.20
C	E	6.60-7.60
C	F	30.15-31.15
C	G	33.00-34.00
C	H	44.50-45.50



W-48A-103

(Code A Pre SB72-3051) Computer Wiring Harness PN 3071816-1
Figure 203

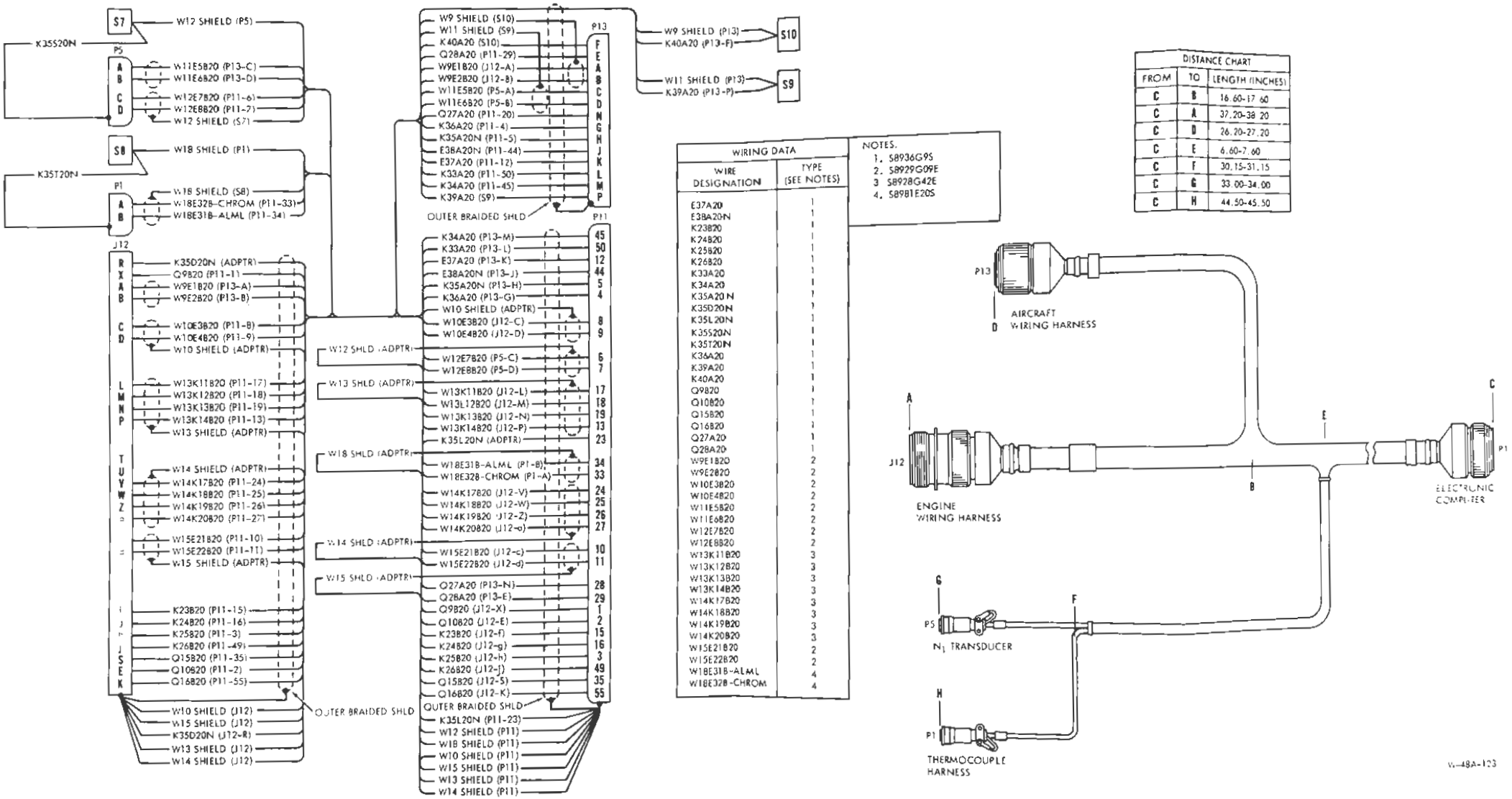


WIRING DATA	
WIRE DESIGNATION	TYPE (SEE NOTES)
E37A20	1
E38A20N	1
K23B20	1
K24B20	1
K25B20	1
K26B20	1
K33A20	1
K34A20	1
K35A20N	1
K35D20N	1
K35L20N	1
K35S20N	1
K35T20N	1
K36A20	1
K39A20	1
K40A20	1
Q9B20	1
Q10B20	1
Q15B20	1
Q16B20	1
Q27A20	1
Q28A20	1
W9E1B20	2
W9E2B20	2
W10E3B20	2
W10E4B20	2
W11E5B20	2
W11E6B20	2
W12E7B20	2
W12E8B20	2
W13K11B20	3
W13K12B20	3
W13K13B20	3
W14K17B20	4
W14K18B20	4
W14K19B20	4
W14K20B20	4
W15E21B20	2
W15E22B20	2
W18E31B-ALML	5
W18E32B-CHROM	5

NOTES:
1. S8936G95
2. S8929G09E
3. S8929G049E
4. S8928G42E
5. S8981E20S

DISTANCE CHART		
FROM	TO	LENGTH INCHES
C	B	16.60-17.60
C	A	37.20-38.20
C	D	26.20-27.20
C	E	6.60-7.60
C	F	30.15-31.15
C	G	33.00-34.00
C	H	44.50-45.50

(Code A Pre SB72-3051) Computer Wiring Harness
Assembly PN 3070054-1 or 3070054-2
Figure 204



WIRING DATA	
WIRE DESIGNATION	TYPE (SEE NOTES)
E37A20	1
E38A20N	1
K23B20	1
K24B20	1
K25B20	1
K26B20	1
K33A20	1
K34A20	1
K35A20N	1
K35D20N	1
K35L20N	1
K35S20N	1
K35T20N	1
K36A20	1
K39A20	1
K40A20	1
Q9B20	1
Q10B20	1
Q15B20	1
Q16B20	1
Q27A20	1
Q28A20	1
W9E1B20	2
W9E2B20	2
W10E3B20	2
W10E4B20	2
W11E5B20	2
W11E6B20	2
W12E7B20	2
W12E8B20	2
W13K11B20	3
W13K12B20	3
W13K13B20	3
W13K14B20	3
W14K17B20	3
W14K18B20	3
W14K19B20	3
W14K20B20	3
W15E21B20	2
W15E22B20	2
W18E31B-ALML	4
W18E32B-CHROM	4

NOTES.
1. S8936G9S
2. S8929G09E
3. S8928G42E
4. S8981E20S

DISTANCE CHART		
FROM	TO	LENGTH (INCHES)
C	B	16.60-17.60
C	A	37.20-38.20
C	D	26.20-27.20
C	E	6.60-7.60
C	F	30.15-31.15
C	G	33.00-34.00
C	H	44.50-45.50

(Code A Post SB72-3051) Computer Wiring Harness Assembly
Figure 205

3. Cleaning/Painting

A. Clean Parts

(1) Clean electronic computer and computer harness assembly in accordance with 72-00-00, GENERAL-CLEANING/PAINTING, Cleaning Method 11.

(2) Bake dry electronic computer air filter by heating in oven at 147C (300F) for no less than two hours.

4. Approved Repairs

A. (Code A) Repair Computer Wiring Harness

(1) On computer wiring harness without braided outer shielding, replace damaged connectors, sleeving, or wiring using standard shop practices.

(2) On computer wiring harness with braided outer shielding, repair broken wires at connectors or replace damaged connectors as follows.

CAUTION: USE CARE WHEN HANDLING BRAIDED OUTER SHIELDING WHEN UNSOLDERED FROM A CONNECTOR. IF SHIELDING BECOMES UNWOVEN, ENTIRE OUTER SHIELDING MUST BE REPLACED.

(a) Unsolder outer shielding at connector to be replaced or to have wiring repaired.

(b) Carefully slide outer shielding back from connector. Do not slide outer shielding back farther than required to perform repairs.

(c) Repair broken connections or replace connector.

(d) Slide outer shielding over wiring and solder in place on connector in same manner as previously installed.

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	203	June 29/79
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	207	June 29/79
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	209	June 29/79
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	214	Blank
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	205	Apr 30/80
	206	Blank
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	216	Apr 30/80
	217	Apr 30/80
	218	Nov 15/79
	219	June 29/79
	220	June 29/79
	221	June 29/79
	222	Blank

RECORD OF TEMPORARY REVISIONS

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R	through							
R	77-5							

CHAPTER 77 - ENGINE INDICATING

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GENERAL - DESCRIPTION AND OPERATION

1. Engine Indicating

The engine has provisions for connection of the following instrumentation sensing elements:

Low pressure rotor rpm (N1 speed signal)
High pressure rotor rpm (N2 speed signal)
Interstage turbine temperature
Oil pressure
Oil Temperature
Planet gear assembly oil inlet temperature
Scavenge oil temperature
Fuel flow
Fuel pressure

The sensing elements, lines and fittings, and electrical circuitry for oil pressure, oil temperature, fuel flow, and fuel pressure are not components of the engine. Refer to the Aircraft Maintenance Manual. The engine rotor speed sensors and interstage turbine temperature thermocouple harness are an integral part of the engine.

2. N1 Speed Signal

N1 speed is measured by the N1 monopole transducer, a magnetic pickup on the aft end of the low-pressure rotor shaft. A speed gear is attached to the low-pressure shaft rotating round the stationary monopole transducer. As the speed gear turns, its teeth cause the magnetic flux path in the air gap to be constantly changing. The dual output monopole transducer produces two separate and identical electrical signals due to the changing magnetic field. The frequency of the output represents rotating speed of the N1 rotating group. One output is routed to the electronic computer and the second output is routed to a cockpit indicator.

3. N2 Speed Signal

The connector for the N2 speed signal of the high pressure rotor is located at the rear of the transfer gearbox. Two outputs are produced by a dual monopole transducer the same as the N1 signal. The monopole transducer is mounted in the transfer gearbox adjacent to the output gear of the transfer gearbox and senses rpm by use of a special gear mounted under the monopole. One output is routed to the electronic computer and the second output is routed to a cockpit indicator.

4. Interstage Turbine Temperature

The turbine gas temperature is measured by Chromel-Alumel thermocouples mounted on the turbine case and extending into the gas path between the high pressure and low pressure turbines. The thermocouples are wired in parallel to form an averaging circuit. The harness is routed through the plenum and terminates in one connector for the electronic computer and a flexible pair of leads for cockpit indication.

5. Oil Pressure

An oil pressure boss is provided on the oil supply manifold for the planet gear assembly for connecting the airframe oil pressure indicating system. Refer to the Aircraft Maintenance Manual.

6. Oil Temperature

A boss is provided on the oil supply manifold for the planet gear assembly for the installation of an oil temperature sensing element. Refer to the Aircraft Maintenance Manual.

7. Fuel Flow

The fuel flow is measured between the fuel control and fuel manifold nozzles. The fuel flow measuring system is not a component of the engine. Refer to the Aircraft Maintenance Manual.

8. Fuel Pressure

A pressure sensing port is provided on the engine fuel pump for instrumenting the fuel pump interstage pressure. The fuel pressure measuring system is not a component of the engine. Refer to the Aircraft Maintenance Manual.

POWER - DESCRIPTION AND OPERATION

1. N1 Transducer

   The N1 monopole transducer is mounted at the rear of the low pressure turbine shaft and provides two electrical signals sensed from the speed pickup gear representing low pressure turbine speed. One signal is routed to the electronic computer and the second signal is routed to a cockpit indicator.

2. Speed Pickup Gear

   The speed pickup gear is mounted on the low pressure turbine shaft and rotates around the N1 transducer which senses the changes in the magnetic field as each gear tooth passes.

3. N2 Transducer

   The N2 transducer is mounted in the transfer gearbox and provides two electrical signals representing high pressure turbine speed. One signal is routed to the electronic computer and the second signal is routed to a cockpit indicator.

N1 TRANSDUCER INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Special Tools, Fixtures and Equipment

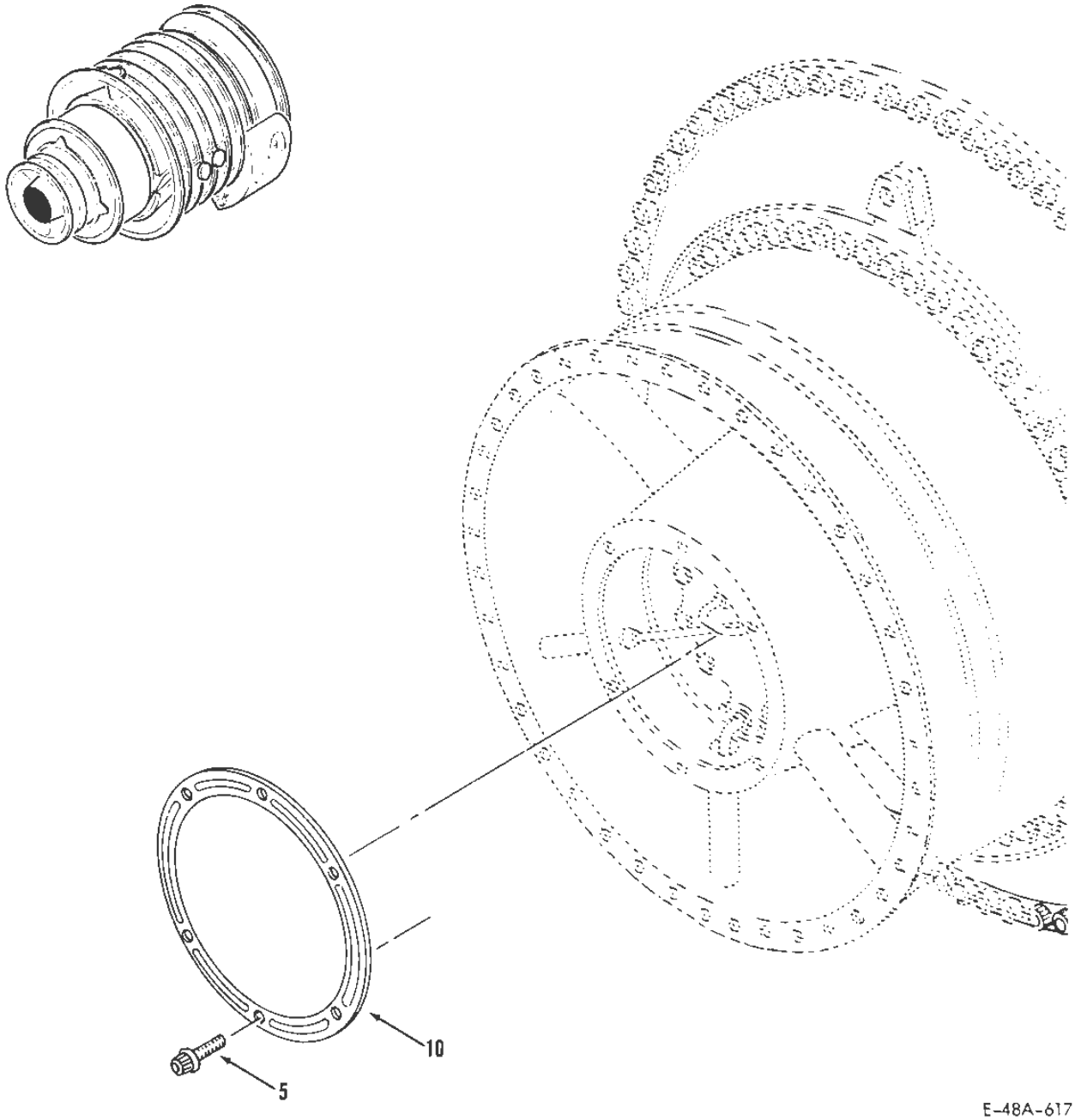
Item No.	Nomenclature	Use	Part No.
NOTE: Equivalent substitutes may be used for listed items.			
1.	Torque Wrench Adapter	Adapts speed pickup gear nut for standard torque wrench.	289750-1
2.	Shaft Holding Wrench	Allows holding tie rod stationary.	289766-1

Table 202. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
High temperature compound (Fel-Pro C5-A)	Fel-Pro Inc, Div of Felt Products Mfg Co, 7450 N McCormick Blvd, Skokie, IL 60076
Lubricating compound (Liqui-Moly, Grade NV, thread compound)	Lockrey Co, Lubricants Div, Cedar Shores, Southampton, NY 11968
Tape (581-9108-1 Fused Quartz Woven Fabric)	Thermal American Fused Quartz Co, Rt 202 and Change Bridge Rd, Montville, NJ 08000

A. Remove N1 Transducer Access Cover Plate (See Figure 201)

(1) Remove bolts and access cover plate from engine.



5. BOLT (IPC FIG. 92)

10. ACCESS COVER PLATE

N1 Transducer Access Cover Plate
Figure 201

CAUTION: THE N1 TRANSDUCER IS A PERMANENT MAGNETIC COMPONENT. THE FOLLOWING HANDLING PRECAUTIONS ARE MANDATORY:

1. TRANDUCER MUST REMAIN IN PROTECTIVE COVERING AT ALL TIMES WHEN REMOVED FROM ENGINE EXCEPT FOR 2. INSPECTION/CHECK PROCEDURES.

2. TRANSDUCER MUST BE HANDLED WITH CARE AND WORKED WITH INDIVIDUALLY.

3. ALL WORK MUST BE DONE ON A NON-MAGNETIC SURFACE USING ONLY NON-MAGNETIC TOOLS.

4. THROUGHOUT PROCEDURES REQUIRING HANDLING AND AT ALL TIMES DURING SHIPPING OR STORAGE, TRANSDUCER MUST NOT BE ALLOWED TO COME WITHIN TWO INCHES OF ANY MAGNETIC SURFACE OR ANY OTHER PERMANENT MAGNETIC COMPONENT.

5. ENSURE ELECTRICAL CONNECTOR IS KEPT COMPLETELY CLEAN. METAL PARTICLES IN CONNECTOR, ATTRACTED BY INTERNAL MAGNETIC COMPONENTS OF TRANSDUCER, WILL RESULT IN SHORTING OF TRANSDUCER OUTPUT.

1. B. Remove N1 Transducer (See Figure 202)

(1) Remove oil tube assemblies connected to bosses on right side and bottom of thrust and exhaust nozzle in accordance with 79-20-04, MAINTENANCE PRACTICES.

(2) Remove N1 transducer access cover plate in accordance with paragraph 1.A.

(3) Remove rear turbine bearing oil tubes in accordance with 79-20-05, MAINTENANCE PRACTICES.

(4) Remove hardware securing N1 transducer lead in accordance with 72-50-03, MAINTENANCE PRACTICES.

(5) Remove nuts, bolts, washer, and clamp securing sensor harness gasket and tab to boss on each of thrust and exhaust nozzle.

(6) Remove nuts from threaded fitting on end of transducer lead.

NOTE: Do not remove bolts securing transducer to transducer support at this time.

1. B. (7) Remove bolts securing assembled items (transducer lead, transducer support, backup plate gasket, backup plate, sensor mount gasket) to internal bolt circle on thrust and exhaust nozzle.

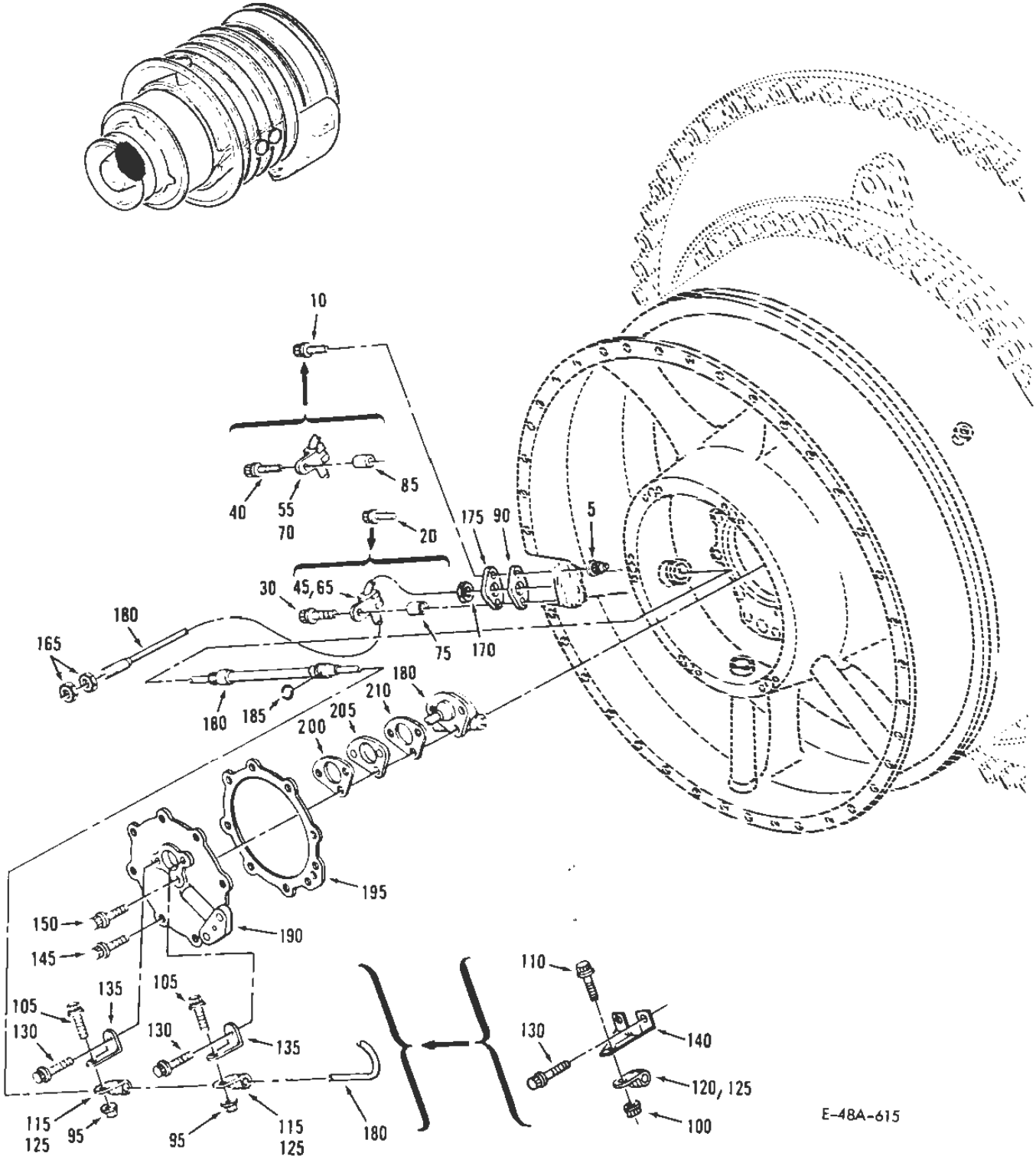
CAUTION: AVOID EXCESSIVE BENDING OR SHARP RADIUS BENDS WHEN STRAIGHTENING TRANSDUCER LEAD. DO NOT STRAIGHTEN ANY EXISTING BENDS MORE THAN REQUIRED FOR REMOVAL OF PART. RADIUS OF LEAD BENDS SHALL NOT BE LESS THAN 0.5 INCH. A BLUNT WOODEN OBJECT MAY BE USED TO APPLY EVEN PRESSURE TO LEAD WHEN STRAIGHTENING EXISTING BENDS.

(8) Straighten existing 90-degree bend where transducer lead exits strut on thrust and exhaust nozzle just enough to permit lead to pass through strut. Use a blunt wooden object to apply even, gradual pressure opposite the 90-degree bend when straightening lead.

(9) Remove bolts. Remove support with assembled parts from thrust and exhaust nozzle as follows.

KEY TO FIGURE 202

5. NUT (IPC FIG. 94)
10. BOLT (CODES A, B)
20. BOLT (CODE C)
30. BOLT (CODES A, B)
40. BOLT (CODE C)
45. CLAMP (CODES A, B)
55. CLAMP (CODE C)
65. TAPE (CODES A, B) (NOT USED ON SMALLER REPLACEMENT CLAMP)
70. TAPE (CODE C) (NOT USED ON SMALLER REPLACEMENT CLAMP)
75. WASHER (CODES A, B)
85. WASHER (CODE C)
90. SENSOR HARNESS GASKET
95. NUT
100. NUT
105. BOLT
110. BOLT
115. CLAMP
120. CLAMP
125. TAPE
130. BOLT
135. BRACKET
140. BRACKET
145. BOLT
150. BOLT
165. NUT
170. NUT
175. TAB
180. N1 TRANSDUCER AND LEAD
185. RETAINING RING
190. TRANSDUCER SUPPORT
195. COVER GASKET
200. BACKUP PLATE GASKET
205. BACKUP PLATE
210. SENSOR MOUNT GASKET



N1 Transducer Installation
Figure 202

1. B. (9) (a) Temporarily mark Position E (figure 203) on transducer lead (four inches beyond point where lead exits exhaust nozzle strut).

NOTE: Throughout operation for removal of transducer lead from strut on thrust and exhaust nozzle, maintain constant downward pressure with thumb at Area F (figure 203). Thumb pressure reduces stress on lead between Points C and D where lead is very susceptible to breakage due to wire work hardening from gas path heat transfer.

(b) Maintain downward thumb pressure at Area F (figure 203) of transducer lead.

(c) Gently pull transducer lead toward engine centerline, while backing off transducer support from bearing support section of thrust and exhaust nozzle. Allow maximum bend radius in lead between Points A and B (figure 203) which allows transducer to just clear flange used to attach transducer access cover.

(d) Continue gently pulling lead out of thrust and exhaust nozzle strut until Point E on lead reaches installed nut (170, figure 202). Make a 75-degree large radius bend in lead at this point.

(e) Remove nut, tab, and gasket.

(f) Remove remainder of lead and gas path tube portions of transducer from thrust and exhaust nozzle strut.

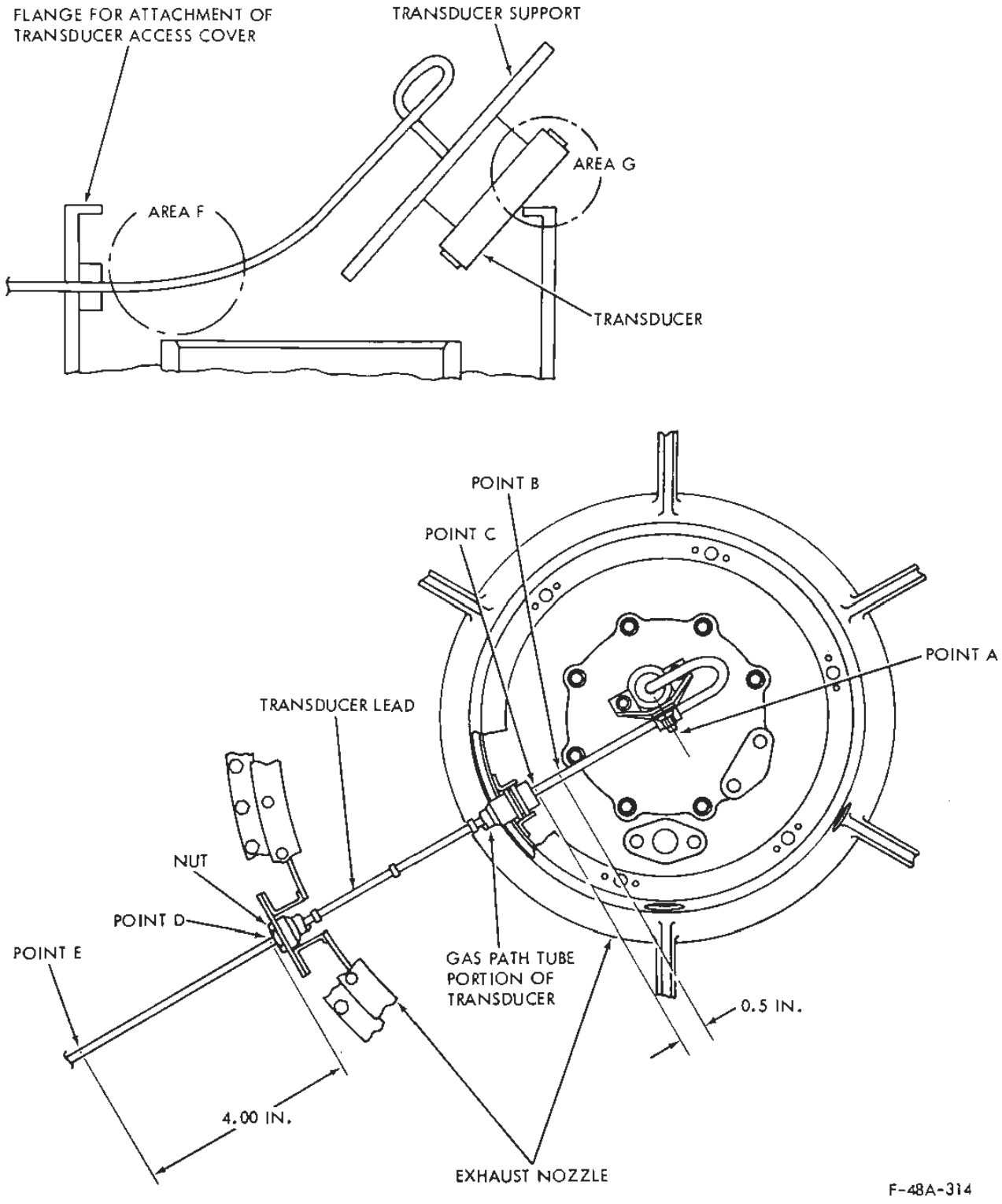
(10) Remove gasket and ring.

(11) Remove bolt then separate support, gasket, plate, and gasket from transducer and lead assembly.

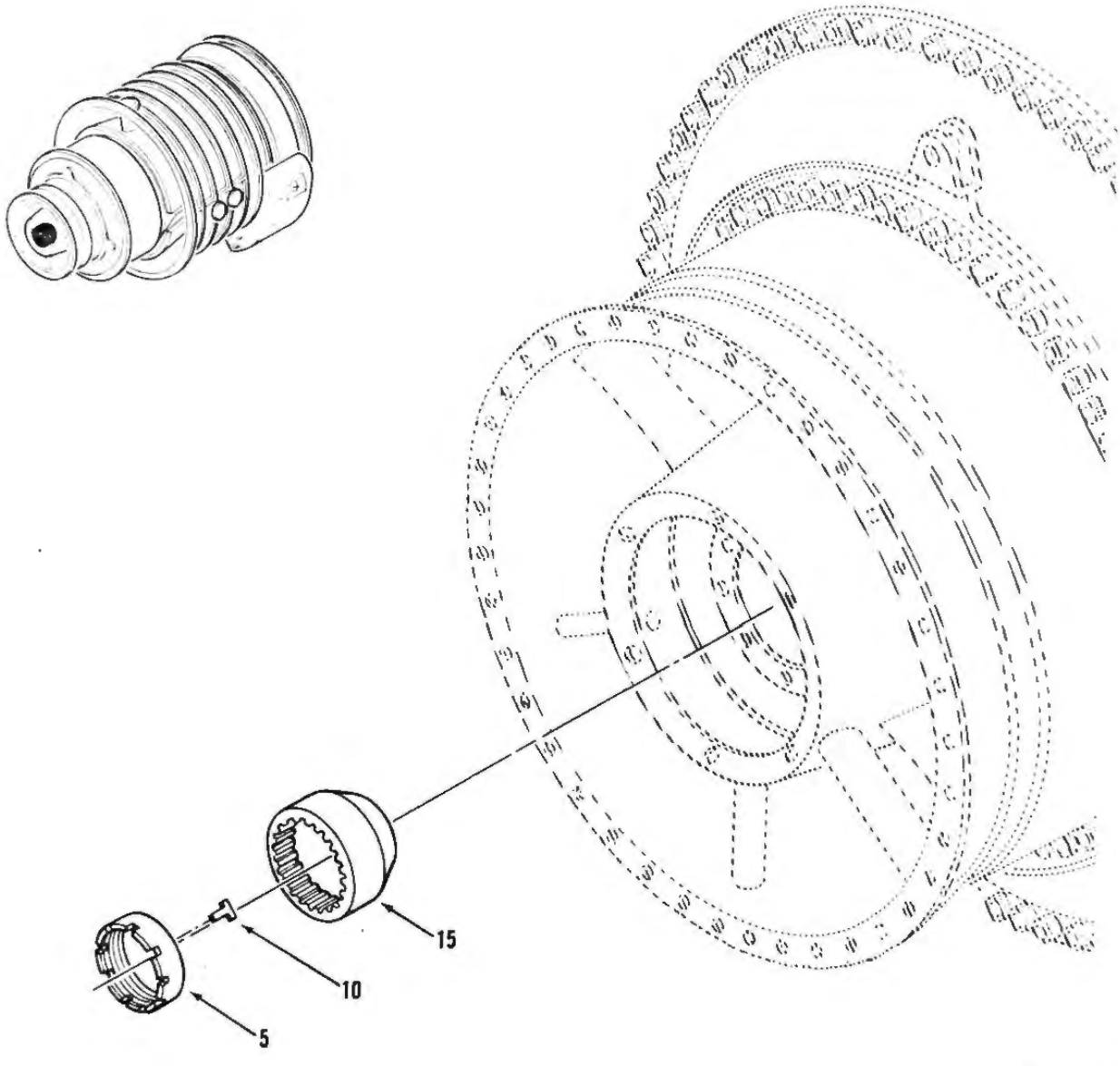
C. Remove Speed Pick-Up Gear (See Figure 204)

(1) Remove N1 transducer in accordance with paragraph 1.B.

(2) Displace locking tab and remove nut with 289750-1 adapter and 289766-1 wrench. Remove key and speed pick-up gear from turbine shaft.



Removal of N1 Transducer
Figure 203



5. NUT (IPC FIG. 95)
10. NUT LOCKING KEY
15. SPEED PICK-UP GEAR

Speed Pick-Up Gear Installation
Figure 204

1. D. Install Speed Pick-Up Gear (See Figure 204)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Position gear on turbine shaft against inner race of bearing.

(2) Apply lubricating compound (Liqui-Moly, Grade NV, thread compound) to threads of shaft and to threads and face of nut. Install nut.

NOTE: Tool required to tighten nut (5) provides an offset of two inches from nut centerline to torque wrench connection point, providing a difference in actual and indicated torques. Calculate indicated torque necessary to obtain required actual torque as described in 70-00-00, STANDARD PRACTICES, paragraph 3.

(3) Using 289750-1 adapter and 289766-1 wrench, tighten nut (5) to torque of 1270 inch-pounds.

(4) Note alignment of shaft slots and castellations on nut to establish suitable location for nut locking key. Note location of shaft slot selected for key.

(5) Loosen nut using 289750-1 adapter and 289766-1 wrench and remove. Install new nut locking key in noted location of shaft slot.

(6) Reinstall nut (5) and tighten to a torque of 1200 inch-pounds using 289750-1 adapter and 289766-1 wrench; continue to tighten nut, if necessary, to align shaft slots and castellation but do not exceed 1400 inch-pounds. Bend tab of nut locking key into slot in nut to lock position.

E. Install N1 Transducer (See Figure 202)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Install speed pick-up gear in accordance with paragraph 1.D.

NOTE: Coat threads of all bolts and nuts with high temperature compound (Fel-Pro C5-A) prior to installation. Just prior to installing assembled parts on engine in the following step, inspect pole pieces (figure 203, area G) of transducer in accordance with step 2.B.(4).

1. E. (2) Assemble items (transducer lead, transducer support, backup plate gasket, backup plate, sensor mount gasket bracket(s)) and secure with bolts. Install clamps on transducer lead and secure with bolts and nuts. Tighten bolts(s) (105 or 110) to torque of 40 inch-pounds. Tighten bolts (130, 150) to torque of 50 inch-pounds.

CAUTION: AVOID EXCESSIVE BENDING OR SHARP RADIUS BENDS WHEN INSTALLING TRANSDUCER LEAD. RADIUS OF LEAD BENDS SHALL NOT BE LESS THAN 0.5 INCH.

(3) Install retaining ring. Thread transducer lead from tube from boss on side of thrust and exhaust nozzle from inside. Secure with nut on threads of transducer lead at boss on side of exhaust nozzle.

NOTE: If smaller replacement clamp (45 or 55) is used, tape is not required.

(Codes A, B) Route transducer lead so that it points downward.

(Code C) Route transducer lead so that it points upward.

(4) Bend transducer lead using 293076-1 radius block. Install bolts, nuts, washer, and clamp securing sensor harness gasket and tab to boss on thrust and exhaust nozzle. Tighten bolts (10, 30 or 20, 40) to torque of 40 inch-pounds.

(5) Position assembled items (transducer lead, transducer support, backup plate gasket, backup plate, sensor mount gasket) on internal bolt circle of thrust and exhaust nozzle and secure with bolts. Tighten bolts (145) to torque of 50 inch-pounds.

CAUTION: HOLD TRANSDUCER LEAD SECURE WHEN TIGHTENING NUTS TO PREVENT DAMAGE TO TRANSDUCER LEAD.

(6) Install nuts at threaded fitting at end of transducer lead.

NOTE: Wrap transducer lead with tape as required at designated areas where lead passes through clamps to secure lead in clamps.

1. E. (7) Secure N1 transducer lead in accordance with 72-50-03, MAINTENANCE PRACTICES.

(8) Install rear turbine bearing oil tubes in accordance with 79-20-06, MAINTENANCE PRACTICES.

(9) Install N1 transducer access cover plate in accordance with paragraph 1.F.

(10) Install oil tube assemblies at bosses on right side and bottom of thrust and exhaust nozzle in accordance with 79-20-04, MAINTENANCE PRACTICES.

F. Install N1 Transducer Access Cover Plate (See Figure 201)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Install N1 transducer in accordance with paragraph 1.E.

(2) Apply high temperature compound (Fel-Pro C5-A) to threads of bolts. Position access cover plate on engine and secure with bolts. Tighten bolts (5) to torque of 50 inch-pounds.

2. Inspection/Check

A. Inspect N1 Transducer Access Cover Plate (See Figure 201)

(1) Inspect access cover plate for cracks and distortion.

(2) Replace access cover plate if cracks or distortion is evident.

B. Inspect N1 Transducer and Lead (See Figure 202)

(1) Inspect pole pieces (figure 203, area G) for evidence
R of damage. Minor surface nicks or scratches
R acceptable.

R (2) Inspect pole pieces for evidence of contact with speed
R pick-up gear. Excessive damage or wear exceeding 25
R percent not acceptable.

N1

2. B. (3) Use ohmmeter to measure resistance across pins A and B (coil for cockpit indicator) and across pins C and D (coil for electronic computer input) on transducer electrical connector. Resistance, at ambient temperature of 21 +11/-11C (70 +20/-20F), shall be 125 +25/-25 ohms for each measurement on units identified as manufactured by Skurka Engineering Co, 160 +30/-30 ohms for each measurement on units identified as manufactured by Garrett Manufacturing Ltd.

CAUTION: DO NOT APPLY VOLTAGE ACROSS INDIVIDUAL WINDINGS (FROM PIN A TO PIN B, OR FROM PIN C TO PIN D) WHEN PERFORMING THE FOLLOWING STEP.

(4) Connect shorting wire across pins A and B and connect shorting wire across pins C and D. Using a megohmmeter, with 500 volts dc output, check for insulation breakdown. Insulation resistance from pins A and B to case, from pins C and D to case, and from pins A and B to pins C and D, shall be a minimum of one megohm for each check. Insulation resistance values below one megohm may be corrected by cleaning electrical connector. Refer to 3, Cleaning/Painting.

(5) Examine pole pieces (figure 203, area G) of transducer under 5X magnification for presence of any magnetic particles. If required, wipe pole pieces with lint-free cloth to remove any particles present.

R (6) Replace N1 transducer and lead assembly if it does not
R meet inspection requirements of steps (1), (2), (3),
R and (4).

C. Inspect Speed Pick-Up Gear (See Figure 204)

R NOTE: Minor surface scratches, marks, or nicks
R are acceptable.

R (1) Inspect gear for evidence of excessive damage caused by
R contact with N1 transducer. Excessive damage not
R acceptable.

R (2) Inspect gear for cracks, broken or chipped teeth.
R Cracks, broken or chipped teeth not acceptable.

3. Cleaning/Painting

A. Clean Parts

Clean parts as specified in Table 204 in accordance with cleaning methods provided in 72-00-00, GENERAL - CLEANING/PAINTING.

Table 204. Cleaning Methods

Figure No.	Index No.	Nomenclature	Cleaning Method 1	2	3	4	5	6	7	8	9	10	11	12
All standard metallic hardware			X	X										
201	10	Cover Plate	X	X										
202	180	N1 Transducer and Lead											X	
	190	Transducer Support	X	X										
	205	Backup Plate	X	X										
204	5	Nut	X	X										
	15	Speed Pick-up Gear	X	X										

N2 TRANSDUCER INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

CAUTION: THE N2 TRANSDUCER IS A PERMANENT MAGNETIC COMPONENT. THE FOLLOWING HANDLING PRECAUTIONS ARE MANDATORY:

1. TRANSDUCER MUST REMAIN IN PROTECTIVE COVERING AT ALL TIMES WHEN REMOVED FROM ENGINE EXCEPT FOR 2, INSPECTION/CHECK PROCEDURES.

2. TRANSDUCER MUST BE HANDLED WITH CARE AND WORKED WITH INDIVIDUALLY.

3. ALL WORK MUST BE DONE ON A NON-MAGNETIC SURFACE USING ONLY NON-MAGNETIC TOOLS.

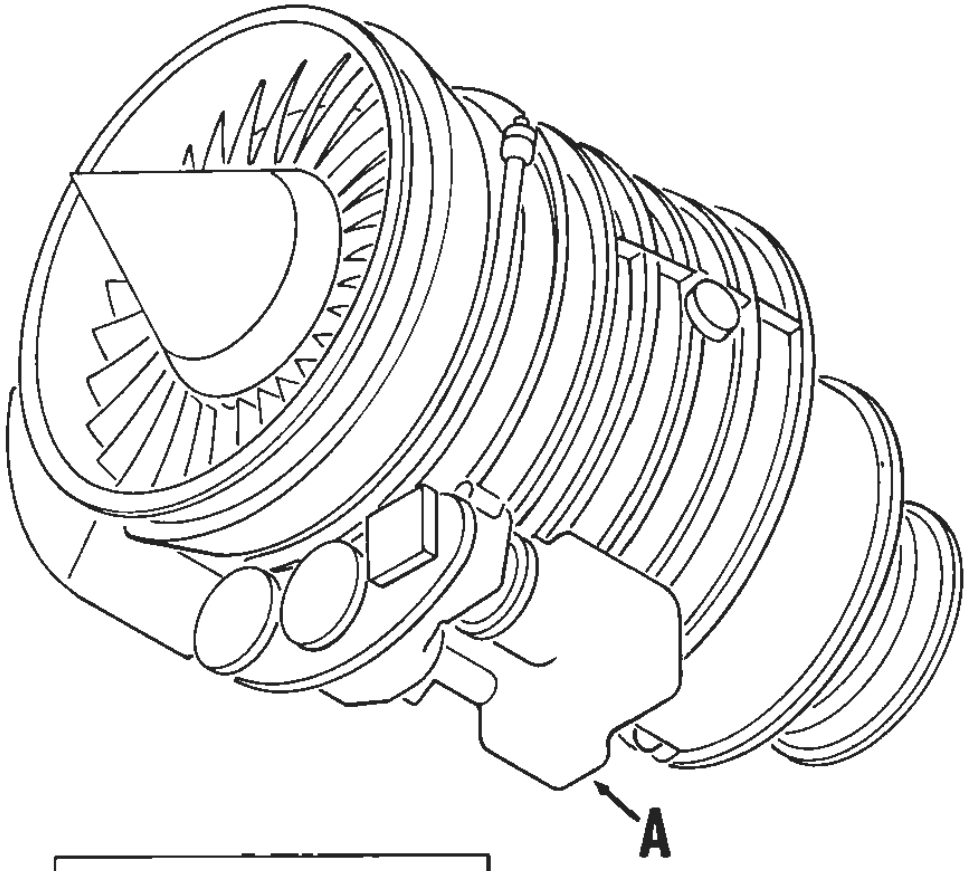
4. THROUGHOUT ALL PROCEDURES REQUIRING HANDLING AND AT ALL TIMES DURING SHIPPING OR STORAGE, TRANSDUCER MUST NOT BE ALLOWED TO COME WITHIN TWO INCHES OF ANY MAGNETIC SURFACE OR ANY OTHER PERMANENT MAGNETIC COMPONENT.

5. ENSURE ELECTRICAL CONNECTOR IS KEPT COMPLETELY CLEAN. METAL PARTICLES IN CONNECTOR, ATTRACTED BY INTERNAL MAGNETIC COMPONENTS OF TRANSDUCER, WILL RESULT IN SHORTING OF TRANSDUCER OUTPUT.

A. Remove N2 Transducer (See Figure 201)

(1) Disconnect wiring harness from N2 transducer.

(2) Remove screws, washers, shims, packing and transducer from transfer gearbox.



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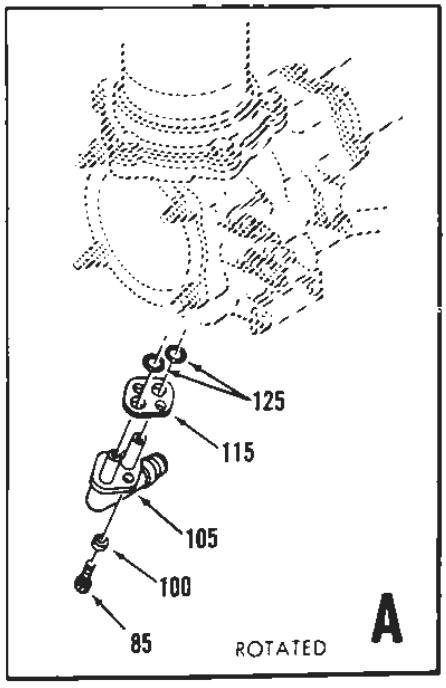


E-48A-768

R 85. SCREW (IPC FIG. 69)
R 100. WASHER
R 105. TRANSDUCER
115. SHIM (THICKNESS AS REQUIRED)
125. PACKING

N2 Transducer Installation
Figure 201

1. B. Install N2 Transducer (See Figure 201)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

The following procedure shall be performed to determine shim thickness required to achieve an air gap of between 0.012 to 0.015 inch for transducer probe No. 1 and transducer probe No. 2. (See figure 202.) Actual shim thickness used will be the greater of the two shim thickness measurements obtained in the following procedure.

(1) Measure distance from mounting surface of transducer to tip of transducer probe No. 1. (See figure 202.) Record as Dimension A.

(2) With a depth micrometer, measure to locate minimum clearance between splines on spacer inside gearbox and transducer mounting boss by rotating gear train at accessory drive gearbox.

(3) With a depth micrometer, measure distance from surface of transducer mounting boss on gearbox housing to spacer teeth. Record as Dimension B.

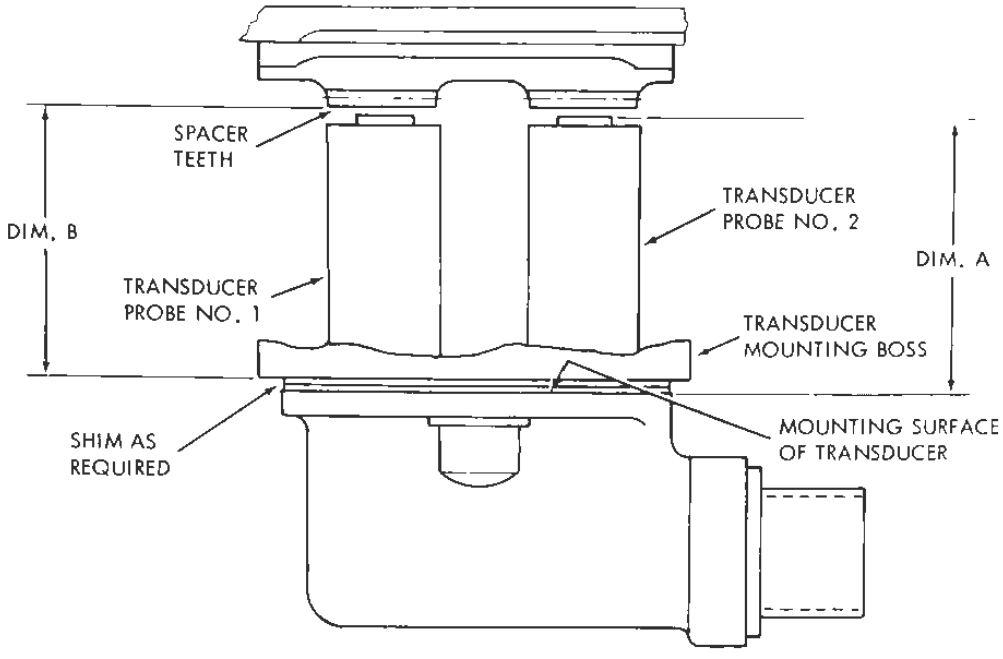
(4) Subtract Dimension B from Dimension A and record as Dimension C. Select shims as required to add to Dimension C to obtain a clearance of 0.012 to 0.015 inch between tip of transducer probe and spacer teeth.

(5) Repeat steps (1) through (4) for transducer probe No. 2. Actual shims required is greater of two measurements determined in step (4).

NOTE: Just prior to installing transducer on gearbox in the following step, inspect pole pieces (tips of probes 1 and 2) of transducer in accordance with 2.A.(5).

(6) Place new packing in gearbox housing. Install selected shims and transducer with new packings and secure with washers and screws. Tighten screws to a torque of 40 inch-pounds.

(7) (Code A) Connect engine wiring harness connector P4 to transducer electrical connector J4. Tighten P4 to torque of 70 to 75 inch-pounds using TG65-1 through TG65-7 strap wrenches (available from Glenair Inc, 1211 Air Way, Glendale, CA 91201).



		PROBE NO. 1	PROBE NO. 2
LENGTH OF PROBE (DIM. A)	=	_____	_____
GRBX DEPTH TO TEETH (DIM. B)	=	_____	_____
DIM. A - DIM. B RESULT (DIM. C)	=	_____	_____

ADD SHIM THICKNESS AS REQUIRED TO OBTAIN CLEARANCE OF 0.012 TO 0.015 INCH.

EXAMPLE 1

DIM. A = 1.146 IN.
DIM. B = 1.160 IN.
DIM. C = 0.014 IN. (WITHIN LIMITS)

EXAMPLE 2

DIM. A = 1.150 IN.
DIM. B = 1.152 IN.
DIM. C = 0.002 IN. (SHIM THICKNESS REQUIRED IS 0.010 TO 0.013 IN. TO MEET CLEARANCE OF 0.012 TO 0.015 IN.)

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Shimming N2 Transducer
Figure 202

2. Inspection/Check

A. Inspect N2 Transducer

R (1) Inspect pole pieces for evidence of damage. Minor surR face nicks or scratches acceptable.

R (2) Inspect pole pieces for evidence of contact with speed
R pick-up spacer. Excessive damage or wear exceeding 25
R percent not acceptable.

R (3) Use ohmmeter to measure resistance across pins A and B
R (coil for cockpit indicator) and across pins C and D
R (coil for electronic computer input) on transducer
R electrical connector. Resistance shall be 800 to 1300
R ohms at ambient temperature of 21 +11/-11C (70 +20/
R -20F).

R CAUTION: DO NOT APPLY VOLTAGE ACROSS INDIVID-
R UAL WINDINGS (FROM PIN A TO PIN B, OR
R FROM PIN C TO PIN D) WHEN PERFORMING
R THE FOLLOWING STEP.

(4) Connect shorting wire across pins A and B and connect shorting wire across pins C and D. Using a megohmmeter, with 500 volts dc output, check for insulation breakdown. Insulation resistance from pins A and B to case, from pins C and D to case, and from pins A and B to pins C and D, shall be a minimum of one megohm for each check. Insulation resistance values below one megohm may be corrected by cleaning electrical connector. Refer to 3, Cleaning/Painting.

(5) Replace N2 transducer if it does not meet inspection
R requirements of steps (1), (2), (3), and (4).

(6) Examine pole pieces (tips of probes 1 and 2) of transducer under 5X magnification for presence of any magnetic particles. If required, wipe pole pieces with lint-free cloth to remove any particles present.

3. Cleaning/Painting

A. Clean N2 Transducer

(1) Clean transducer in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method 11.

R (2) Clean screws, washers, and shims in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method 1 or 2.

TEMPERATURE - DESCRIPTION AND OPERATION

1. General

The turbine gas temperature is measured by Chromel-Alumel thermocouples mounted on the turbine case and extending into the gas path between the high pressure and low pressure turbines. Two thermocouple rakes of five probes each are wired in parallel to form an averaging circuit. The ten probes in the assembly present an average sensed temperature. The harness is routed through the plenum and terminated in two leads to provide connections for the electronic computer and for cockpit indication. The lead providing the signal for the electronic computer terminates with a connector.

R THERMOCOUPLE HARNESS INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Special Tools, Fixtures and Equipment

Item No.	Nomenclature	Use	Part No.
NOTE: Equivalent substitutes may be used for listed items.			
1.	Shaft Support and Alignment Fixture (Codes A, B)	Supports tie rod end.	289783-1
2.	Shaft Support and Alignment Fixture (Code C)	Supports tie rod end.	291926-1
3. R R	*Low Pressure Shaft Stretching Fixture (with cylinder and pump)	Stretches tie rod.	291960-1 or 291960-2

NOTE: *A fluorescent penetrant inspection in accordance with Specification MIL-I-6866, Type I, is required on 292374-1 threaded rod and 290489-1 nut to ensure serviceability at 60 day intervals or after each 100 times fixture is loaded (whichever occurs first). Maintain a permanent record with stretching fixture to record number and dates of fixture loading and dates of inspections. Life limit of 292374-1 threaded rod and 290489-1 nut is 6,000 fixture loadings. These components shall be replaced at or before reaching life limit.

Table 202. Materials and Compounds

Material or Compound	Manufacturer
CAUTION: ANY SUBSTITUTES USED FOR LISTED INDUSTRIAL MARKING INK OR YELLOW CHINA MARKER SHALL CONTAIN NO CARBON.	
NOTE: Equivalent substitutes may be used for listed items.	
High temperature compound (Fel-Pro C5-A)	Fel-Pro Inc, Div of Felt Products Mfg Co, 7450 N McCormick Blvd, Skokie, IL 60076
Industrial marking ink (Violet No. 127-1/2)	Pannier Corp, 207 Sandusky St, Pittsburgh, PA 15212
Lubricating compound (Liqui-Moly, Grade NV, thread compound)	Lockrey Co, Lubricants Div, Cedar Shores, Southampton, NY 11968
Yellow china marker (No. 170T)	Blaisdell Pencil Co, Philmont Rd, Bethagres, PA 19006

A. Remove Thermocouple Harness (See Figure 201)

(1) Remove oil tube assemblies connected at bosses on right side and bottom of thrust and exhaust nozzle in accordance with 79-20-04, MAINTENANCE PRACTICES.

(2) Remove N1 transducer access cover plate in accordance with 77-10-03, MAINTENANCE PRACTICES.

(3) Remove rear turbine bearing oil tubes in accordance with 79-20-05, MAINTENANCE PRACTICES.

(4) Remove hardware securing thermocouple harness and N1 transducer lead in accordance with 72-50-03, MAINTENANCE PRACTICES.

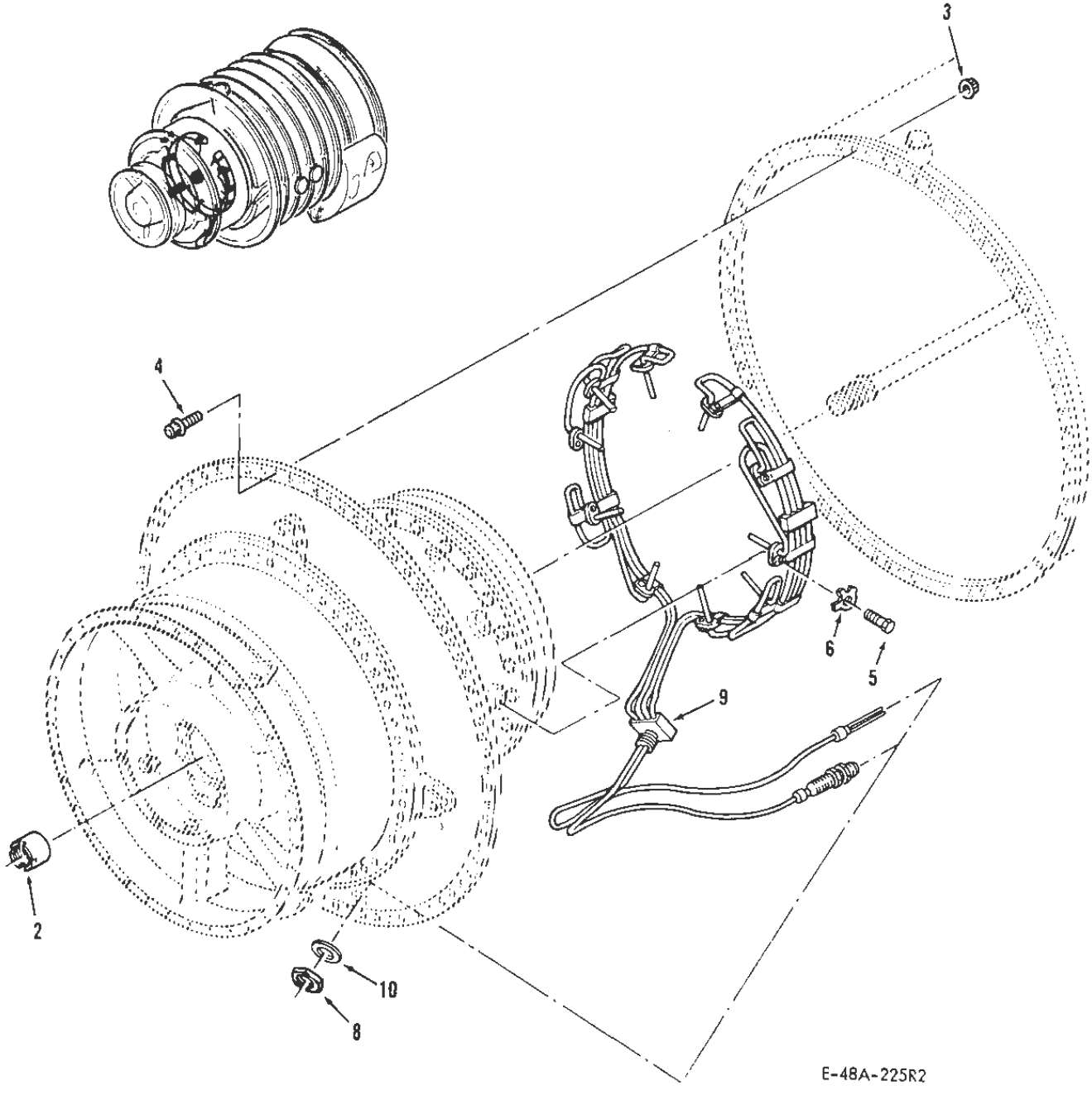
(5) Remove N1 transducer installation in accordance with 77-10-03, MAINTENANCE PRACTICES.

NOTE: Removal of the low pressure tie rod nut requires a vibration check after reinstallation. Refer to 72-00-00, GENERAL - ADJUSTMENT/TEST, paragraph 12.

1. A. (6) Mark relative positions of shaft on turbine module and tie rod with yellow china marker (No. 170T) or industrial marking ink (Violet No. 127-1/2).

NOTE: Dimensions and respective positions recorded in the following steps are for use at reassembly of the assembled duct-nozzle-low pressure turbine module to ensure correct tie rod stretch and radial alignment of curvic coupling teeth.

Hand load the turbine module forward (with approximately 15 pounds of force) during all dimensional measurements.



2. TIE ROD NUT (IPC FIG. 99)
3. NUT (IPC FIG. 107)
4. BOLT
5. BOLT
6. TAB LOCK
8. NUT
9. THERMOCOUPLE HARNESS
10. WASHER

R

Thermocouple Harness Installation
Figure 201

1. A. (7) Measure and record Dimension D (on worksheet of Table 203) from Surface A on thrust and exhaust nozzle to Surface B on turbine module third stage shaft. (See figure 202.) Mark points used for measurement using yellow china marker (No. 170T) or industrial marking ink (Violet No. 127-1/2).

(8) Measure and record Dimension E (on worksheet of Table 203) from Surface A on thrust and exhaust nozzle to Surface C on end of tie rod. (See figure 202.) Mark points used for measurement using yellow china marker (No. 170T) or industrial marking ink (Violet No. 127-1/2).

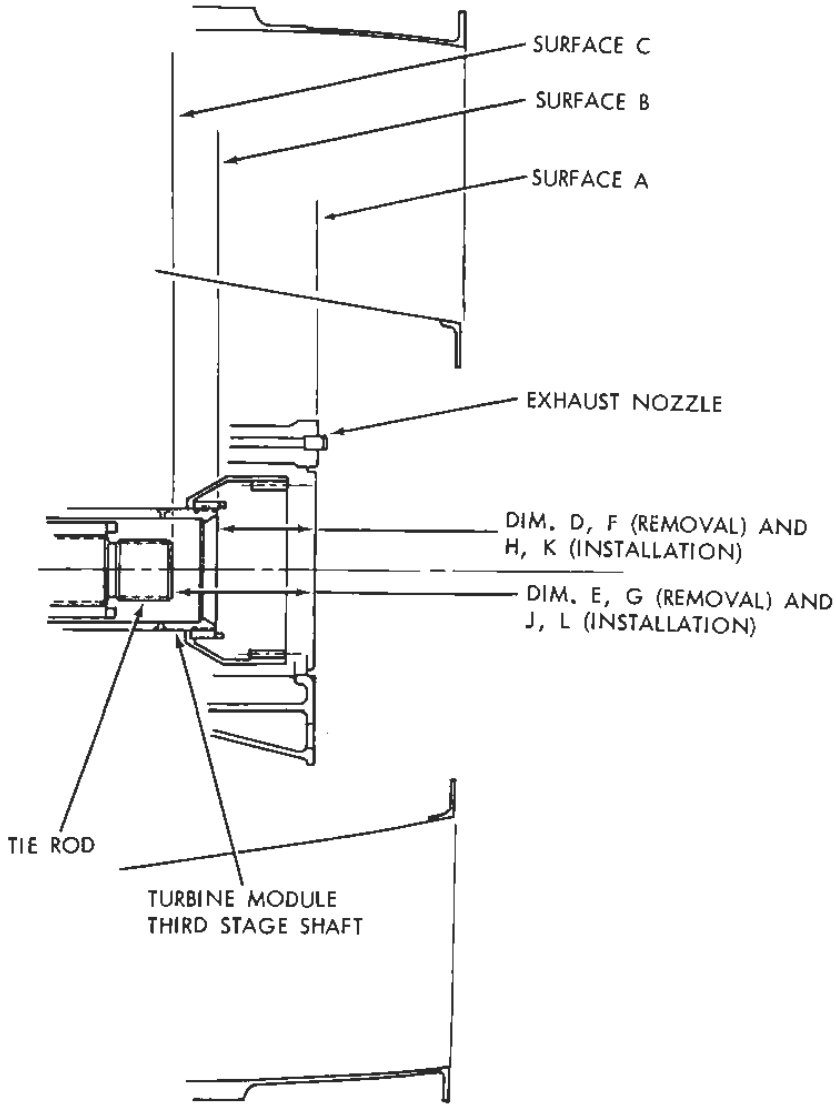
WARNING: DO NOT STAND BEHIND, ABOVE, OR BELOW SHAFT STRETCH FIXTURE WHEN PRESSURE IS APPLIED TO FIXTURE IN THE FOLLOWING STEPS. A FAILURE OF FIXTURE OR ENGINE TIE ROD WOULD EXPEL FIXTURE AFT WITH CONSIDERABLE FORCE.

CAUTION: WHEN PERFORMING THE FOLLOWING PROCEDURE, MAKE CERTAIN FORCE SPECIFIED IS NOT EXCEEDED TO ENSURE SHAFT IS NOT OVERSTRETCHED. ENSURE PROPER SPECIAL TOOLING IS USED.

ROD PORTION OF SHAFT STRETCH FIXTURE MUST BE INSTALLED AND POSITIONED AS DESCRIBED IN THE FOLLOWING STEPS PRIOR TO APPLICATION OF PRESSURE TO FIXTURE TO AVOID LOCKING ROD AGAINST NUT.

R (9) Loosen tie rod nut when using 291960-1 or 291960-2
R fixture.

R (a) Disassemble 291960-1 or 291960-2 fixture to
R separate threaded rod and wrench. Clean threads
R of fixture components and mating threads for fix-
R ture on engine component. Lubricate threads on
R threaded rod of fixture with a light coat of lu-
R bricating compound (Liqui-Moly, Grade NV, thread
R compound). Install brass nut of fixture onto exposed threads of third stage shaft to protect threads during stretch of tie rod in the following steps. Install brass nut to a depth that positions aft face of nut 0.010 to 0.030 inch forward of end of third stage shaft.



I-48A-211

Curvic Coupling Teeth Alignment Check
Figure 202

Table 203. Tie Rod Stretch and Curvic Coupling Radial Alignment Worksheet

Date:_____ Engine Serial No.:_____ Technician:_____

	Para. Ref	Dimensions to be Recorded (Fig. 202)	Surfaces Measurement (Fig. 202)	Conditions
	LP Turbine Removal			
	1.A.(7)	Dim. D:_____	A to B	Tie rod stretched.
	1.A.(8)	Dim. E:_____	A to C	Tie rod stretched.
	1.A.(10)	Dim. F:_____	A to B	Tie rod unstretched (tie rod nut hand tight).
	1.A.(11)	Dim. G:_____	A to C	Tie rod unstretched (tie rod nut hand tight)
	LP Turbine Installation			
	1.B.(11)	Dim. H:_____	A to B	Tie rod unstretched (tie rod nut hand tight). Dimension H shall equal Dimension F,
R				+0.015/-0.015* inch.
	1.B.(12)	Dim. J:_____	A to C	Tie rod unstretched (tie rod nut hand tight). Dimension J shall equal Dimension G,
R				+0.015/-0.015* inch.
R	1.B.(15)	Dim. K:_____	A to B	Tie rod stretched.
R	1.B.(16)	Dim. L:_____	A to C	Tie rod stretched.

NOTE: *If components other than those removed are installed, use tolerance of 0.030 inch instead of 0.015 inch for dimension comparison.

Keep worksheets for each LP turbine removal/installation performed with permanent engine records.

NOTE: Steps (b) through (e) are performed to ensure maximum thread engagement of fixture rod and tie rod before final positioning of fixture rod and applying hydraulic pressure to fixture.

1. A. (9) (b) Apply a small amount of lubricating compound (Liqui-Moly, Grade NV, thread compound) to face of fixture rod which will contact aft face of tie rod nut when rod is bottomed.

(c) Thread fixture rod onto exposed threads of tie rod until rod bottoms against aft face of tie rod nut. Make reference mark on end of fixture rod to aid counting turns, then back fixture rod out, counting turns required to remove rod. Note number of turns required.

(d) Inspect aft face of tie rod nut to ensure presence of lubricating compound (Liqui-Moly, Grade NV, thread compound). Presence of lubricating compound (Liqui-Moly, Grade NV, thread compound) indicates full engagement of fixture rod with tie rod nut when rod is threaded onto tie rod with number of turns noted in previous step.

CAUTION: A MINIMUM OF NINE AND ONE-FOURTH THREADS SHALL BE ENGAGED WHEN PERFORMING THE FOLLOWING STEP. IF LESS THAN NINE AND ONE-FOURTH TURNS ARE COUNTED WHEN INSTALLING FIXTURE ROD, DO NOT CONTINUE PROCEDURE.

(e) Thread fixture rod onto exposed threads of tie rod to bottoming position, ensuring same number of threads are engaged as noted in step (c).

CAUTION: BACKING FIXTURE ROD OUT FROM BOTTOMING POSITION MORE THAN TWO AND ONE-FOURTHS TURNS IN THE FOLLOWING STEP MAY NOT PROVIDE SUFFICIENT THREAD ENGAGEMENT AND CAUSE FAILURE OF TIE ROD OR FIXTURE.

1. A. (9) (f) Hold rotating group of engine stationary with hand and back rod out two and one-fourth turns to ensure tie rod nut can be loosened when pressure is applied to fixture.

(g) Slide wrench portion of fixture forward over rod to engage tie rod nut.

(h) Carefully assemble adapter and cylinder assembly of fixture over rod. Secure assembly with fixture bushing and wing nut on end of rod holding fixture forward against third stage shaft of turbine module. Install bushing and wing nut to bottoming position, then back wing nut out one and one-half turns. Ensure rod does not turn with wing nut.

(i) Use hand pressure align cylinder assembly of fixture concentrically with fixture rod, then apply sufficient pressure with hydraulic pump of fixture to support cylinder in aligned position.

R (j) (Post SB72-3119) Slowly continue to apply pressure with hydraulic pump of fixture until fixture
R pressure gage indicates 4400 psig.

R (j1) (Pre SB72-3119) Slowly continue to apply pressure
R with hydraulic pump of fixture until fixture pres-
R sure gage indicates 5550 psig.

CAUTION: WHEN REQUIRED TO INCREASE HYDRAULIC PRESSURE ON FIXTURE AS SPECIFIED IN THE FOLLOWING STEP, DO NOT EXCEED MAXIMUM HYDRAULIC PRESSURE SPECIFIED ON FIXTURE.

(k) Turn fixture wrench to rotate tie rod nut counterclockwise. If tie rod nut will not loosen, release hydraulic pressure on fixture and repeat steps (i) through (k) to loosen nut. If tie rod nut will not loosen after four repetitions, repeat steps (i) through (k) with hydraulic pressure increased 50 psig over previously used hydraulic pressure. Continue repetitions until tie rod nut is loosened, but do not exceed maximum hydraulic pressure specified on fixture.

1. A. (9) (l) Turn fixture wrench to rotate tie rod nut counterclockwise until tie rod nut bottoms against rod of fixture, then rotate tie rod nut one-half turn clockwise.

(m) Slowly relieve hydraulic pressure, then remove fixture.

NOTE: Hand load the turbine module forward (with approximately 15 pounds of force) during all dimensional measurements.

(10) Measure and record Dimension F (on worksheet of Table 203) from Surface A on thrust and exhaust nozzle to Surface B on turbine module third stage shaft. (See figure 202.) Ensure measurement is taken from points marked during initial measurement.

(11) Measure and record Dimension G (on worksheet of Table 203) from Surface A on thrust and exhaust nozzle to Surface C on tie rod. (See figure 202.) Ensure measurement is taken from points marked during initial measurement.

(12) Remove mounting brackets and related hardware from outer bolt circle of transition duct in accordance with 72-50-03, MAINTENANCE PRACTICES.

NOTE: Approximate weight of duct-nozzle-low-pressure turbine module assembly is 100 pounds.

(13) Remove tie rod nut. Remove nuts and bolts securing assembled duct-nozzle-low-pressure turbine module assembly to plenum case. Remove assembled duct-nozzle-low pressure turbine module assembly from engine.

(14) Install 289783-1 fixture to support tie rod.

(15) Remove nut and washer from harness at connector mounting pad on assembled duct-nozzle-low pressure turbine module assembly.

CAUTION: AVOID EXCESSIVE BENDING OR SHARP RADIUS BENDS IN LEADS WHEN REMOVING THERMOCOUPLE HARNESS. RADIUS OF LEAD BENDS SHALL NOT BE LESS THAN 0.5 INCH. USE PARTICULAR CARE AT POINT WHERE LEADS EXIT PLENUM.

(16) Remove bolts, tab locks, and thermocouple harness from duct-nozzle-low pressure turbine assembly.

1. B. Install Thermocouple Harness (See Figure 201)

CAUTION: AVOID EXCESSIVE BENDING OR SHARP RADIUS BENDS IN LEADS WHEN INSTALLING THERMOCOUPLE HARNESS. RADIUS OF LEAD BENDS SHALL NOT BE LESS THAN 0.5 INCH.

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Position thermocouple harness on assembled duct-nozzle-low pressure turbine module assembly by feeding lead connector portion through hole in lower portion of transition duct and the probes in the mounting flanges on the periphery of the transition duct. Install nut portion of thermocouple harness over lead connector portion and turn onto threads of block protruding from transition liner to secure. Tighten nut (8) portion to a torque value of 225 $\pm$25 inch-pounds and lockwire to adjacent bolt securing thrust and exhaust nozzle.

(2) Inspect for sharp edge on step of interstage transition duct between probe circle of harness and junction box of harness that attaches to duct. If sharp edge exists where harness leads cross step, stone off sharp edge to prevent chafing of metal encasement on harness leads.

(3) Ensure a clearance of 0.010 to 0.060 inch is maintained between metal encasement for harness leads (between junction box attaching to duct and probe circle) and surface of interstage transition duct. Total overall height of thermocouple harness from surface of transition duct shall be no more than 0.280 inch. There shall be no metal-to-metal contact. Recontour metal encasement, if required, to obtain clearance.

(4) Apply high temperature compound (Fel-Pro C5-A) to threads of bolts, install new tab locks and bolts, and secure thermocouple harness to transition duct. Tighten bolts (5) to torque value of 60 inch-pounds and secure with tabs on tab locks.

NOTE: Align high spot of LP turbine shaft (noted by V or I on one curvic tooth) 180 degrees from the high spot on the fourth stage LP compressor shaft (noted by V or I on one curvic tooth).

1. B. (5) Remove 289783-1 or 291926-1 fixture supporting tie rod.

(6) Position duct-nozzle-low pressure turbine assembly on plenum case, ensuring indexing marks on turbine module shaft and tie rod are aligned. If turbine module shaft has no indexing marks, install turbine module with high point marks (V or I) on mating curvic couplings 180 degrees apart. Verify engagement by turning turbine module rotating group back and forth and noting that fan rotor assembly rotates. With curvic couplings properly engaged, hand load turbine module forward until tie rod nut is installed.

(7) Apply lubricating compound (Liqui-Moly, Grade NV, thread compound) to threads of tie rod and to threads and face of tie rod nut. Install tie rod nut on tie rod hand tight. Wipe off any excess lubricating compound and ensure aft face of tie rod nut is clean.

(8) Apply high temperature compound (Fel-Pro C5-A) to threads of bolts used to secure duct-nozzle-low pressure turbine module assembly.

(9) Install mounting brackets and related hardware from outer bolt circle of transition duct in accordance with 72-50-03, MAINTENANCE PRACTICES.

(10) Secure duct-nozzle-low pressure turbine assembly with bolts and nuts. Tighten bolts (4) to torque of 80 inch-pounds.

NOTE: Hand load the turbine module forward (with approximately 15 pounds of force) during dimensional measurements of the following steps.

(11) Measure and record Dimension H (on worksheet of Table 203) from Surface A on thrust and exhaust nozzle to Surface B on third stage turbine module shaft. (See figure 202.) Ensure measurement is taken from points marked during removal.

(12) Measure and record Dimension J (on worksheet of Table 203) from Surface A on thrust and exhaust nozzle to Surface C on tie rod. (See figure 202.) Ensure measurement is taken from points marked during removal.

NOTE: It is permissible that the dimensional requirement of the following step be within 0.030 inch of measurement recorded in 1.A.(10) and (11) if components other than those removed at disassembly are installed.

1. B. (13) Compare Dimension H (step 1.B.(11)) with Dimension F (step 1.A.(10)) recorded at removal. Compare Dimension J (step 1.B.(12)) with Dimension G (step 1.A.(11)) recorded at removal. Compared dimensions shall be the same within 0.015 inch. If dimensions are not as specified, curvic coupling teeth are not properly aligned. If required, remove assembled duct-nozzle-low pressure turbine assembly and repeat steps (3) through (11) to obtain correct curvic coupling teeth alignment.

WARNING: DO NOT STAND BEHIND, ABOVE, OR BELOW SHAFT STRETCH FIXTURE WHEN PRESSURE IS APPLIED TO FIXTURE IN THE FOLLOWING STEPS. A FAILURE OF FIXTURE OR ENGINE TIE ROD WOULD EXPEL FIXTURE AFT WITH CONSIDERABLE FORCE.

CAUTION: WHEN PERFORMING THE FOLLOWING PROCEDURE, MAKE CERTAIN FORCE SPECIFIED IS NOT EXCEEDED TO ENSURE TIE ROD IS NOT OVERSTRETCHED. IF SPECIFIED STRETCH IS EXCEEDED, APPLY PRESSURE WITH SHAFT STRETCH FIXTURE (NOT TO EXCEED PRESSURE SPECIFIED FOR SHAFT STRETCH FIXTURE USED) SUFFICIENT TO LOOSEN TIE ROD NUT, RELIEVE HYDRAULIC PRESSURE ON FIXTURE, AND REPEAT PROCEDURE. ENSURE LOAD REACTS THROUGH ROTATING GROUP AND NOT AGAINST STATIC STRUCTURE. ENSURE PROPER SPECIAL TOOLING IS USED.

(14) (Post SB72-3119) Stretch tie rod as follows using
R 291960-1 or 291960-2 fixture to obtain dimensional stretch of 0.0695 to 0.0715 inch.

R (a) Disassemble 291960-1 or 291960-2 fixture to
R separate threaded rod and wrench. Clean threads
R of fixture components and mating threads for fix-
R ture on engine component. Lubricate threads on
R threaded rod of fixture with a light coat of lu-
R bricating compound (Liqui-Moly, Grade NV, thread
R compound). Install brass nut of fixture onto exposed threads of third stage turbine module shaft to protect threads during stretch of tie rod in the following steps. Install brass nut to a depth that positions aft face of nut 0.010 to 0.030 inch forward of end of third stage rotor shaft.

NOTE: Steps (b) through (e) are performed to ensure maximum thread engagement of fixture rod and tie rod before applying hydraulic pressure to fixture.

1. B. (14) (b) Apply a small amount of lubricating compound (Liqui-Moly, Grade NV, thread compound) to face of fixture rod which will contact aft face of tie rod nut when rod is bottomed.

(c) Thread fixture rod onto exposed threads of tie rod until rod bottoms against aft face of tie rod nut. Make reference mark on end of fixture rod to aid counting turns, then back fixture rod out, counting turns required to remove rod. Note number of turns required.

(d) Inspect aft face of tie rod nut to ensure presence of lubricating compound (Liqui-Moly, Grade NV, thread compound). Presence of lubricating compound (Liqui-Moly, Grade NV, thread compound) indicates full engagement of fixture rod with tie rod when rod is threaded onto tie rod with number of turns noted in previous step.

CAUTION: A MINIMUM OF SEVEN THREADS SHALL BE ENGAGED WHEN PERFORMING THE FOLLOWING STEPS. IF LESS THAN SEVEN TURNS ARE COUNTED WHEN INSTALLING FIXTURE ROD, DO NOT CONTINUE PROCEDURE.

(e) Thread fixture rod onto exposed threads of tie rod to bottoming position, ensuring same number of threads are engaged as noted in step (c). Do not back rod out from this position.

(f) Slide wrench portion of fixture forward over rod to engage tie rod nut.

(g) Carefully assembly adapter and cylinder assembly of fixture over rod. Secure assembly with wing nut on end of rod holding fixture forward against third stage shaft of turbine module. Install wing nut to bottoming position, then back wing nut out one-fourth turn.

1. B. (14) (h) Use hand pressure to align cylinder assembly of fixture aligned concentrically with fixture rod, then apply sufficient pressure with hydraulic pump of fixture to support cylinder in aligned position.

(i) Slowly continue to apply pressure with hydraulic pump of fixture until fixture pressure gage indicates 2700 to 3000 psig. Turn fixture wrench clockwise to seat tie rod nut hand tight. Support cylinder assembly of fixture with hand pressure and slowly release pressure on fixture. Thread rod of fixture onto tie rod until rod bottoms on tie rod nut. Engage fixture wrench on tie rod nut. Tighten fixture wing nut on rod of fixture, then back out one-fourth turn.

(j) Use hand pressure to align cylinder assembly of fixture aligned concentrically with fixture rod, then apply sufficient pressure with hydraulic pump of fixture to support cylinder in aligned position.

(k) Slowly continue to apply pressure with hydraulic pump of fixture until fixture pressure gage indi-
R cates 4400 psig.

(l) Turn fixture wrench clockwise to tighten tie rod nut hand tight.

(m) Slowly relieve hydraulic pressure on fixture and remove fixture.

CAUTION: WHEN REQUIRED TO INCREASE HYDRAULIC PRESSURE ON FIXTURE AS SPECIFIED IN THE FOLLOWING STEP, DO NOT EXCEED MAXIMUM HYDRAULIC PRESSURE SPECIFIED ON FIXTURE.

NOTE: Take measurement at previously made markings.

(n) Measure tie rod stretch to ensure tie rod has been
R stretched 0.0695 to 0.0715 inch. If stretch is less than specified, proceed as follows:

1) Thread fixture rod onto tie rod to bottoming position.

1. B. (14) (n) 2) Carefully assemble adapter and cylinder assembly of fixture over rod, using care not to damage exposed threads of third stage shaft on low pressure turbine module. Secure assembly with wing nut on end of rod, holding fixture forward against third stage turbine module shaft. Install nut to bottoming position, then back wing nut out one-fourth turn.

3) Repeat steps (j) through (m) with hydraulic pressure applied in step (k) increased 50 psig at each repetition of procedure until specified stretch is obtained. Do not exceed maximum hydraulic pressure specified on fixture.

NOTE: Hand load the turbine module forward (with approximately 15 pounds of force) during all dimensional measurements.

(15) Measure and record Dimension K (on worksheet of Table 203) from Surface A on thrust and exhaust nozzle to Surface B on turbine module third stage shaft. (See figure 202.) Ensure measurement is taken from points marked during removal.

(16) Measure and record Dimension L (on worksheet of Table 203) from Surface A on thrust and exhaust nozzle to Surface C on tie rod. (See figure 202.) Ensure measurement is taken from points marked during removal.

(17) Install N1 transducer installation (except for transducer access cover plate) in accordance with 77-10-03, MAINTENANCE PRACTICES.

(18) Secure thermocouple harness and N1 transducer leads in accordance with 72-50-03, MAINTENANCE PRACTICES.

(19) Install rear turbine bearing oil tubes in accordance with 79-20-05, MAINTENANCE PRACTICES.

1. B. (20) Install N1 transducer access cover plate in accordance with 77-10-03, MAINTENANCE PRACTICES.

(21) Install oil tube assemblies at bosses on right side and bottom of thrust and exhaust nozzle in accordance with 79-20-04, MAINTENANCE PRACTICES.

(22) Perform vibration check in accordance with 72-00-00, GENERAL - ADJUSTMENT/TEST, paragraph 12 or 13.

2. Inspection/Check

A. Inspect Thermocouple Harness

(1) Inspect harness for evidence of damage from excessive heat. Inspect harness welded and brazed areas for cracks which would allow entrance of moisture through metal encasement.

(2) Inspect metal encasement of ITT harness leads for evidence of chafing at point between junction box attaching to interstage transition duct and probe circle. Chafing resulting from action of metal encasement against duct is acceptable if notch or chafe mark is no deeper than 0.018 inch into metal encasement.

(2a) Inspect probes of thermocouple harness for notching caused by erosion. Notching in metal encasement on probes shall not exceed depth of 0.035 inch, and notch length shall not extend more than 180 degrees around circumference of probe.

(3) Perform resistance check of harness. Resistance across pins A-B of the indicator circuit shall be 3 to 7 ohms at ambient temperature of 21 +11/-11C (70 +20/-20F). Resistance across pins A-B of the control circuit shall be 3 to 7 ohms at ambient temperature of 21 +11/-11C (70 +20/-20F).

CAUTION: DO NOT APPLY MORE THAN 100 VOLTS DC WHEN PERFORMING THE FOLLOWING STEP.

(4) Check for insulation resistance of at least 50 kilohms between pins and case at room temperature with 100 volts dc applied. Low insulation resistance may be caused by contamination of electrical connector. If low, clean connector in accordance with 3, Cleaning/Painting, then repeat check. Another cause of low insulation resistance may be moisture in J10 leads due to broken moisture seal at termination of lead insulation. Dry out moisture and reseal leads, if applicable, in accordance with Service Bulletin 77-3003. Insulation resistance failure may be caused by shorting

of a lead by ferrule at junction of braided shielding and tubular metal lead encasement on J10 leads. Refer to 4, Approved Repairs.

2. A. (5) Check harness functionally.

(a) Connect digital voltmeter (Model 3200 with DP100 Module. Hickok Electrical Instrument Co, 10514 DuPont Ave, Cleveland, Ohio 44108, or equivalent) across harness indicator circuit leads. Connect voltmeter positive lead to Chromel lead (J10 yellow).

(b) Using 260C (500F) temperature heat gun or propane torch, heat each harness probe one at a time while observing digital voltmeter. Small voltmeter deflection shall be observed when each probe is heated, indicating probe is operational. Replace harness if deflection is not noted for each probe.

(c) Using 260C (500F) temperature heat gun or propane torch, heat each harness junction box and bulkhead connector (connecting harness leads at point where leads exit transition duct when installed on engine) one at a time while observing voltmeter. Any deflection on voltmeter greater than 0.1 millivolt while a junction box or the bulkhead connector is being heated requires replacement of thermocouple harness.

(d) Disconnect voltmeter from indicator circuit and connect across control circuit electrical connector pins J1-A and J1-B. Connect voltmeter positive lead to chromel pin J1-A and negative lead to alumel pin J1-B.

(e) Repeat steps (b) and (c).

(f) Remove voltmeter.

(6) Visually inspect moisture seal at termination of lead insulation on J10 leads. Dry out moisture and reseal leads, if applicable, in accordance with Service Bulletin 77-3003.

(7) Replace harness if it does not meet requirements of steps (1) through (5) and damage is beyond scope of 4, Approved Repairs.

3. Cleaning/Painting

A. Clean Parts

(1) Clean all standard metallic hardware in accordance with 72-00-00, GENERAL-CLEANING/PAINTING, Cleaning Method 1 or 2.

(2) Clean tie rod nut in accordance with 72-00-00, GENERAL-CLEANING/PAINTING, Cleaning Method 1 or 2.

(3) Clean thermocouple harness in accordance with 72-00-00, GENERAL-CLEANING/PAINTING, Cleaning Method 11.

4. Approved Repairs

Table 204. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Ferrule (2053-7)	Temptron, 8744 Remmet Ave, Canoga Park, CA 91304
Heat-shrink tubing	Commercially available
Tape (Mylar)(0.004 inch thick)	Commercially available
Potting compound (Stycast 2662)	Emerson and Cuming Inc, 59 Walpole, Canton, MA

A. Repair Shorted Shielding on Thermocouple Harness

(1) On ferrule at junction of braided shielding and tubular metal lead encasement of J10 (indicator) leads, locate and mark ferrule circumference 0.5 inch from small crimped end.

(2) Using hand grinder, grind through ferrule linearly from small end at high points of crimp to marked circumference at two locations 180 degrees apart. Do not grind deeper than necessary to cut through ferrule and expose potting compound.

(3) Cut through marked circumference using jeweler's saw and remove two halves of ferrule end. Do not cut deeper than required to cut through ferrule and expose potting compound.

4. A. (4) Carefully remove exposed potting compound using razor blade.

(5) Cut away one inch of braided shielding measured from cut circumference on ferrule, using small wire cutters or scissors to expose insulated leads.

(6) On exposed lead with damaged insulation, strip approximately 0.75 inch of insulation to remove damaged portion.

(7) Wrap lead where insulation has been removed with tape (Mylar) using at least three thicknesses of tape.

(8) Wrap insulated leads together with tape (Mylar), using two to three thicknesses of tape.

NOTE: It may be required to remove customer-installed terminals at J10 to allow installation of components in subsequent steps of this procedure. If required, remove terminals in accordance with Aircraft Maintenance Manual.

(9) Slide one-inch length of heat-shrink tubing over J10 leads to cover taped area. Shrink tubing in place with hot-air gun.

(10) Wrap junction of braided shielding and insulated leads adjacent to repair area using one-fourth inch wide tape (Mylar). Wrap tape to thickness which provides fit with small end of new ferrule (2053-7) to be used.

(11) Cut off 0.4 inch from large end of new ferrule (2053-7) to be used.

(12) Slide ferrule (2053-7) over J10 leads (large end first).

(13) Position large end of ferrule (2053-7) approximately 0.15 inch from cut end of existing ferrule. If necessary, tape new ferrule at small end to hold position.

(14) Fill cavity of ferrule with potting compound (Stycast 2662). If required to make potting compound flow easily into cavity and fill voids, warm potting area slightly using hot-air gun.

4. A. (15) If installed, remove tape from small end of new ferrule. Butt edges of new and existing ferrules together. Wipe off excess potting compound. Hold ferrule ends butted together for twenty minutes while heating with hot-air gun to begin curing of potting compound. Allow an additional twelve hours of curing time at room temperature.

(16) If customer-furnished terminals at J10 were removed, re-install terminals in accordance with Aircraft Maintenance Manual.

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	Maintenance Practices		201
	Removal/Installation		201
	Inspection/Check		201
	Cleaning/Painting		201

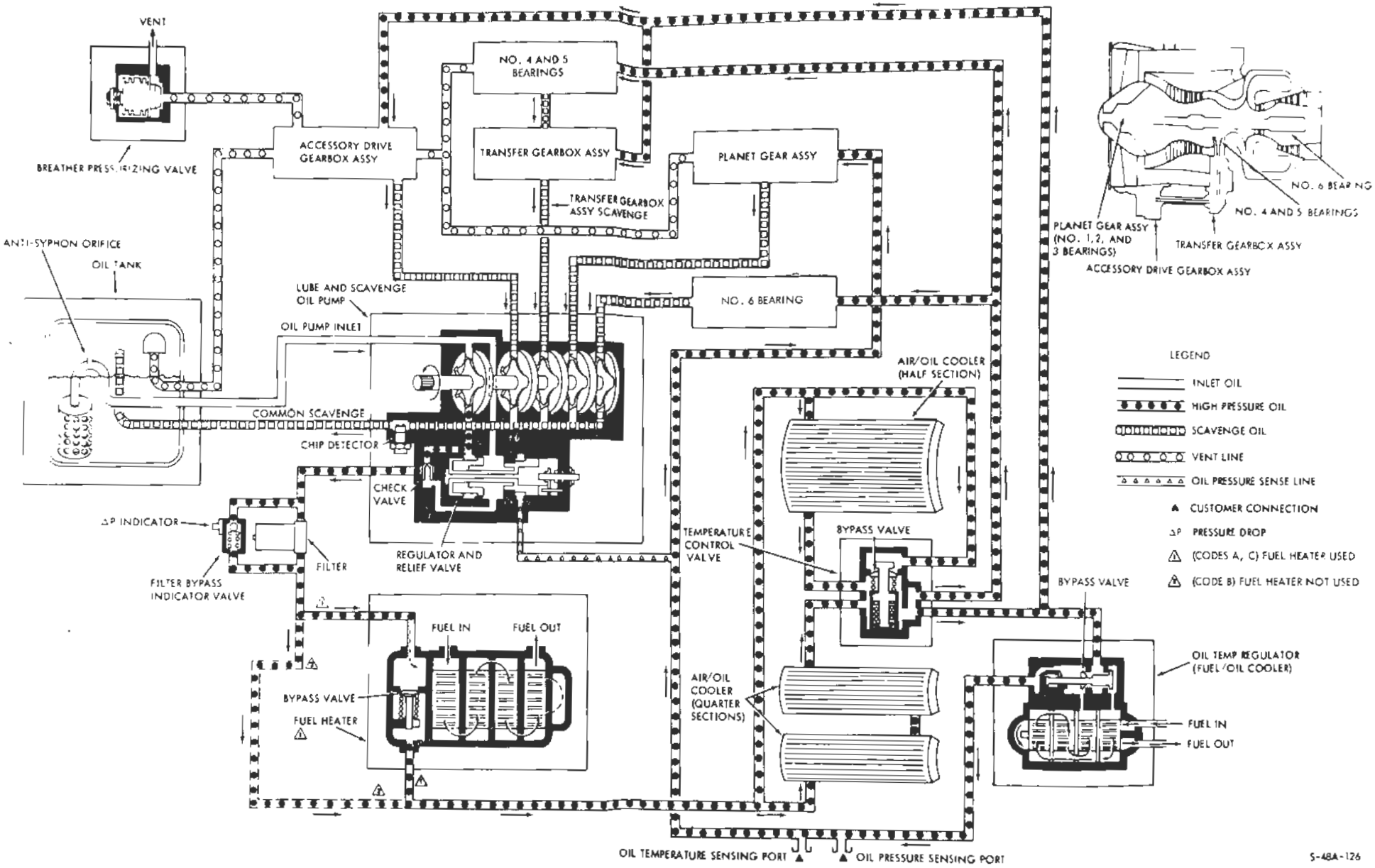
GENERAL - DESCRIPTION AND OPERATION

1. Oil

The oil is drawn from an oil tank by the oil pressure pump and is passed through the pressure-regulating valve, the oil filter, and through to the surface oil (air/oil) coolers.

(Codes A, C) A fuel heater is installed in the oil system down stream of the oil filter to heat inlet fuel to the fuel filter and prevent fuel icing.

The air/oil coolers comprise a three-segment finned cooler that forms the inner surface of the engine fan duct. From the oil-to-air air/oil coolers, the oil flow is divided so that part of the flow is directed to the accessory drive and transfer gearboxes and the engine bearings. The remaining oil passes through the oil temperature regulator (fuel/oil cooler), exchanging heat from oil to fuel, and is then delivered to the planet gear assembly. Both the air/oil coolers and the fuel/oil cooler are equipped with thermostatic bypass valves to maintain the oil at the desired minimum temperature during operation. The air/oil cooler system is equipped with a drain plug to drain the finned air/oil coolers. The oil system schematic is illustrated in Figure 1.



Oil System Diagram
Figure 1

STORAGE - DESCRIPTION AND OPERATION

1. General

The oil tank is a six quart capacity. It is mounted on the right-hand outside of the fan bypass housing. The tank is equipped with a coarse screen at the oil suction intake. The
R tank is equipped with a liquid level gage to check tank quantity and a filler cap.

A filler tube with an integral cap and dipstick on the left side of the engine provides a means of filling the oil tank and checking the tank quantity for those engines mounted such that
R the liquid level gage is inaccessible.

The oil tank installation includes all of the connecting tubes and elbows, as well as the oil tank.

OIL TANK INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
R Compound (permatex 1372W) R	Loctite Corp, 705 N Mountain Rd, Newington, CT 06111
R Methyl-ethyl-ketone (MEK) R (Federal Specification R TT-M-261)	Commercially available

A. Remove Tank-to-Pump Tubes (See Figures 201 or 202)

(1) (Code A (Series 35 and Subq), Code B (Series 20 and Subq), Code C) Remove nuts, bolt, clamp, and bracket securing cooler-to-lube jets tube assembly to aft end of oil pump in accordance with 79-20-07, MAINTENANCE PRACTICES.

(2) Remove nuts, bolts, clamps, and brackets used to secure oil tubes.

(3) Remove nuts, bolts, washers, and retainers securing oil tubes, adapter, and elbow. Remove oil tubes, adapter, and elbow, then remove packings.

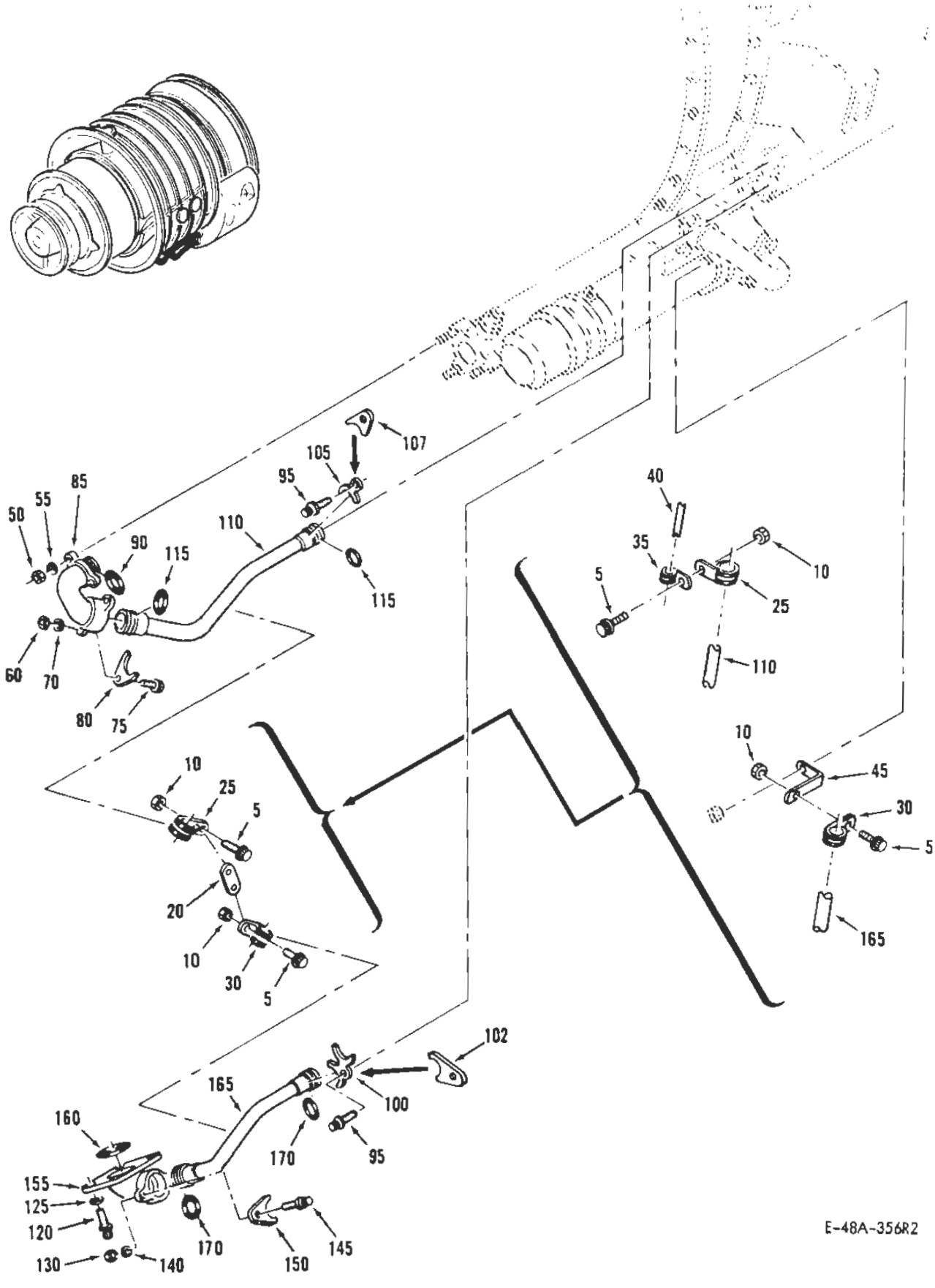
B. Remove Vent and Filler Tube Installation (See Figure 203)

(1) Remove bolts and retainers securing vent tube and elbow, then remove vent tube, elbow, and packings. On vent tube utilizing plug, remove plug and packing.

(2) Remove nuts, bolts, washers, clamp, and retainer securing filler tube, then remove filler tube and packing. Remove gage or plug from filler tube, then remove packing from gage or plug.

(3) (Code A) If clamp is utilized on grounding cable, remove clamp.

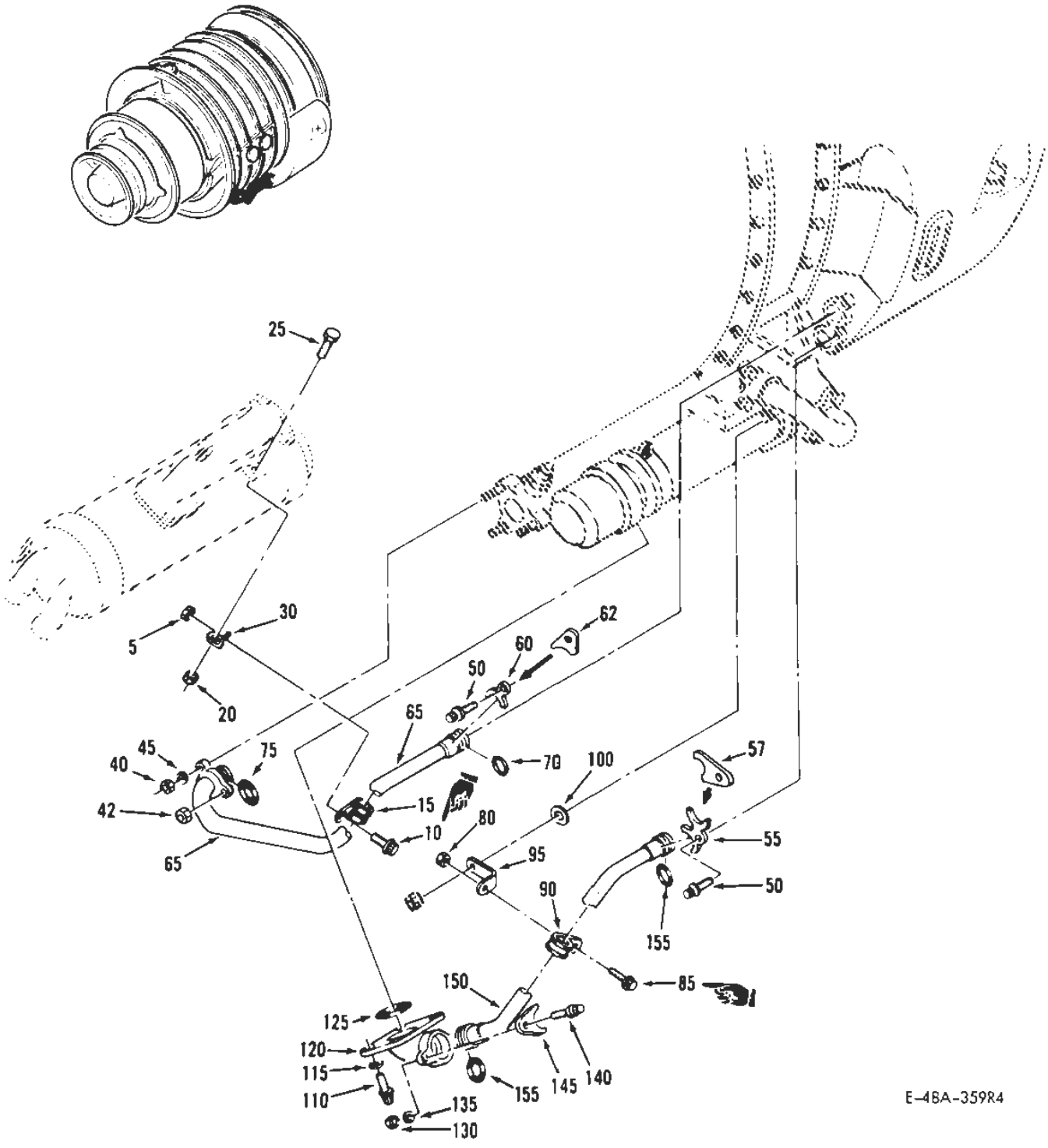
R



(Codes A, B) Oil Tank Plumbing Installation
Figure 201

KEY TO FIGURE 201

5.	BOLT (IPC FIG. 45)
10.	NUT
20.	BRACKET (PART DELETED)
25.	CLAMP
30.	CLAMP
35.	CLAMP (PART ADDED)
40.	OIL PRESSURE SENSING TUBE ASSY
45.	BRACKET (PART ADDED)
50.	NUT
55.	WASHER
60.	NUT
70.	WASHER
75.	BOLT
80.	RETAINER
85.	ELBOW
90.	PACKING
95.	BOLT
100.	LOCK PLATE
102.	LOCK PLATE
105.	LOCK PLATE
107.	LOCK PLATE
110.	OIL TRANSFER TUBE
115.	PACKING
120.	BOLT
125.	WASHER
130.	NUT
140.	WASHER
145.	BOLT
150.	RETAINER
155.	APAPTER
160.	PACKING
165.	OIL TUBE
170.	PACKING

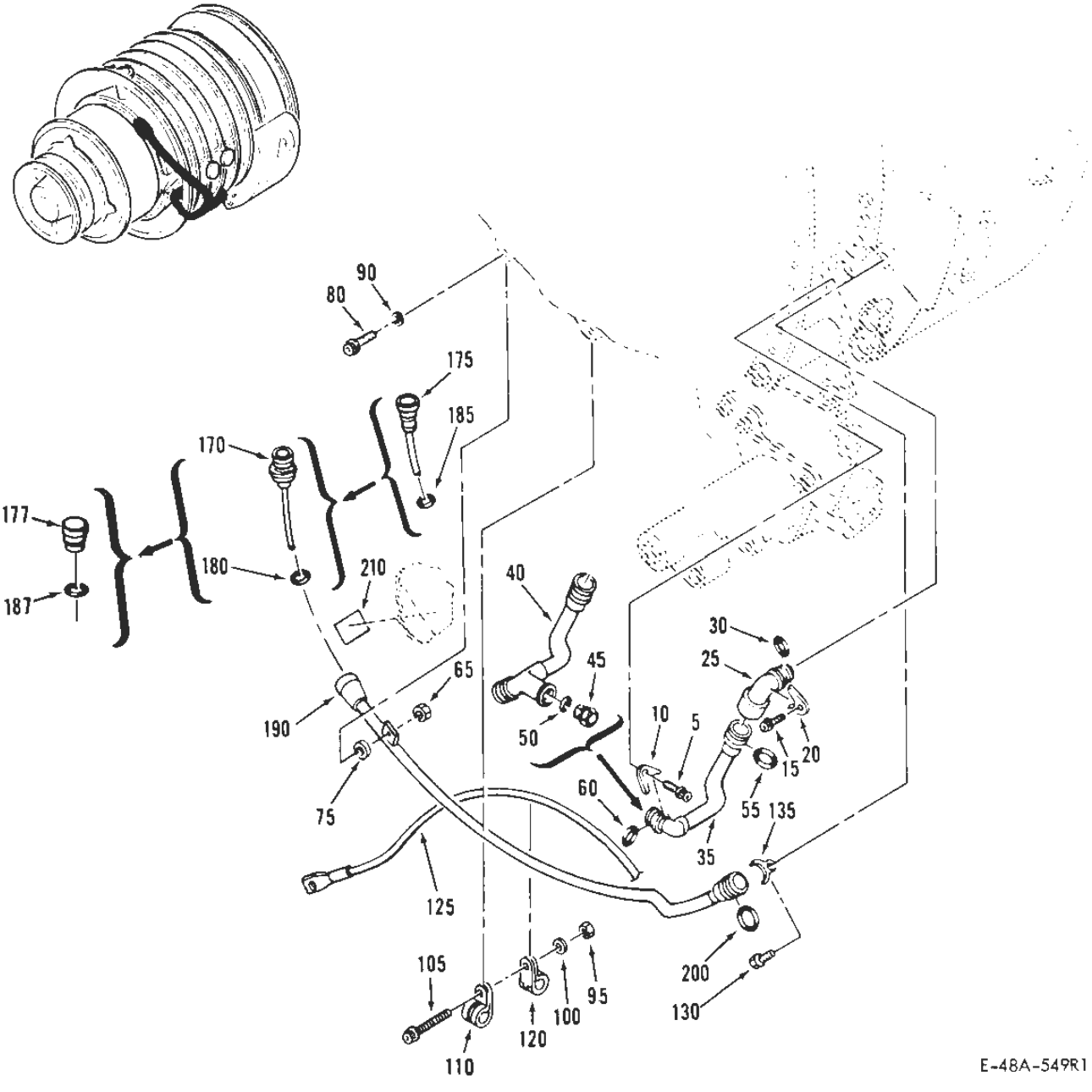


(Code C) Oil Tank Plumbing Installation
Figure 202

KEY TO FIGURE 202

5.	NUT (IPC FIG. 46)	75.	PACKING
10.	BOLT	80.	NUT
15.	CLAMP	85.	BOLT
20.	NUT	90.	CLAMP
25.	BOLT	95.	BRACKET
30.	BRACKET	100.	WASHER
40.	NUT	110.	BOLT
42.	NUT	115.	WASHER
45.	WASHER	120.	ADAPTER
50.	BOLT	125.	PACKING
55.	LOCK PLATE	130.	NUT
57.	LOCK PLATE	135.	WASHER
60.	LOCK PLATE	140.	BOLT
62.	LOCK PLATE	145.	RETAINER
65.	SCAVENGE TUBE	150.	OIL TUBE
70.	PACKING	155.	PACKING

R



Vent and Filler Tube Installation
Figure 203

KEY TO FIGURE 203

5.	BOLT (IPC FIG. 47)
10.	RETAINER
15.	BOLT
20.	RETAINER
25.	ELBOW
30.	PACKING
35.	VENT TUBE
40.	VENT TUBE
45.	PLUG
50.	PACKING
55.	PACKING
60.	PACKING
65.	NUT
75.	WASHER (CODE B)
80.	BOLT
90.	WASHER
95.	NUT
100.	WASHER
105.	BOLT
110.	CLAMP
120.	CLAMP (CODE A) (PART DELETED)
125.	GROUNDING CABLE (CODE A)
130.	BOLT
135.	RETAINER
170.	GAGE (CODES A, B)
175.	GAGE (CODES A, B)
177.	PLUG (CODE C)
180.	PACKING (CODES A, B)
185.	PACKING (CODES A, B)
187.	PACKING (CODE C)
190.	FILLER TUBE
200.	PACKING
210.	DECAL (CODES A, B)

1. C. Remove Oil Tank (See Figure 204)

(1) Remove nuts, bolts, screws, washers, and bushings securing upper and lower mount links to engine. Remove mount links.

(2) Remove screws and mounting strip securing oil tank to engine. Remove filler plug and packing from oil tank.

(3) If required to replace defective parts, remove screws securing retainer and lens. Remove retainer and lens, gasket, and ball from oil tank.

(4) Remove drain plug and packing from oil tank.

D. Install Oil Tank (See Figure 204)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Install drain plug with packing on oil tank. Tighten drain plug (105) to torque of 120 to 130 inch-pounds.

(2) If retainer and lens and gasket were removed at disassembly, reinstall components as follows.

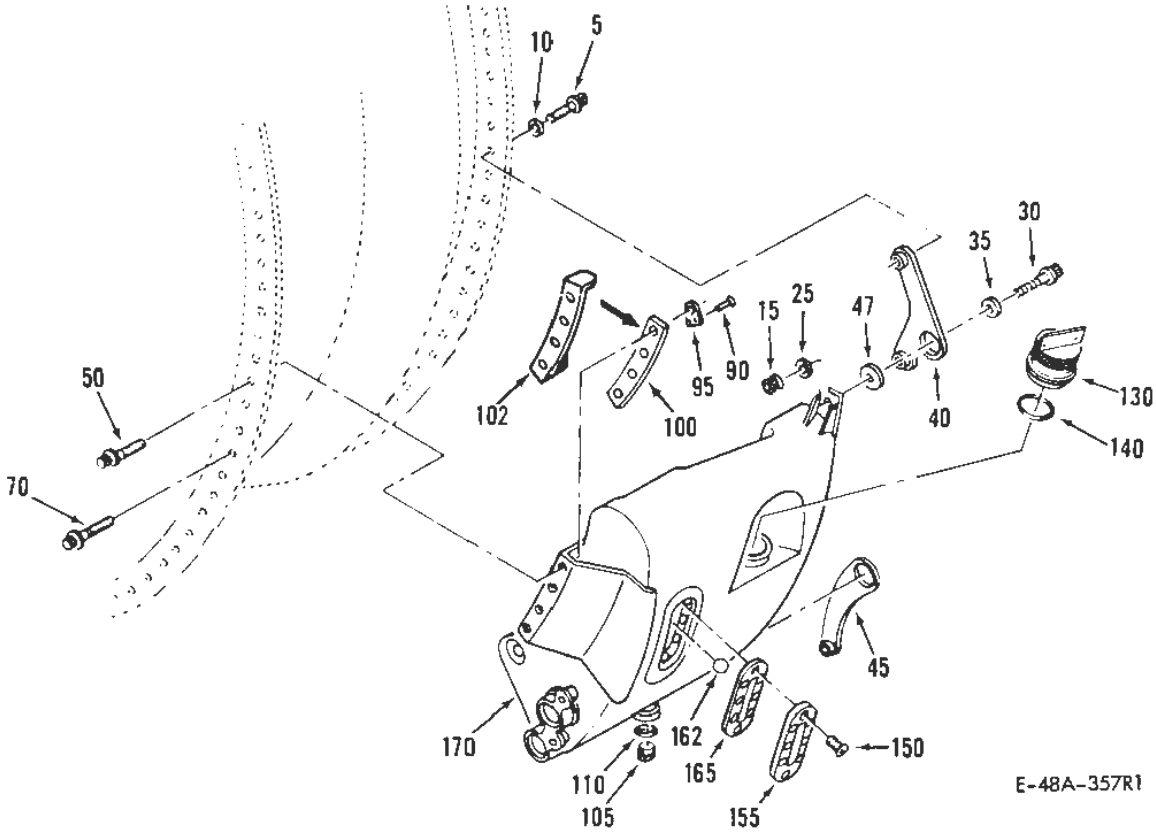
(a) Install ball.

R (b) Ensure all residue of compound (from last assembly
R operation) has been cleaned from gasket mating
R surfaces on oil tank, retainer and lens, and
R threads of screws using methyl-ethyl-ketone (MEK)
R (Federal Specification TT-M-261).

R (c) Apply thin coat of compound (Permatex 1372W) to
R each side of gasket.

CAUTION: IMPROPER INSTALLATION OF SCREWS (150) MAY RESULT IN BREAKAGE OF RETAINER AND LENS.

(d) Install gasket and retainer and lens on oil tank with screws. Install screws (150) until screw heads just bottom on retainer and lens.



5.	BOLT (IPC FIG. 48)	* 95.	NUTPLATE
10.	WASHER	100.	TANK MOUNTING STRIP
15.	NUT	102.	TANK MOUNTING STRIP
25.	WASHER	105.	DRAIN PLUG
30.	SCREW	110.	PACKING
35.	WASHER	130.	FILLER PLUG
40.	UPPER MOUNT LINK	140.	PACKING
45.	LOWER MOUNT LINK	150.	SCREW
47.	MOUNT LINK BUSHING	155.	RETAINER AND LENS
50.	SCREW OR BOLT	162.	BALL
70.	BOLT OR SCREW	165.	GASKET
*90.	RIVET	170.	OIL TANK

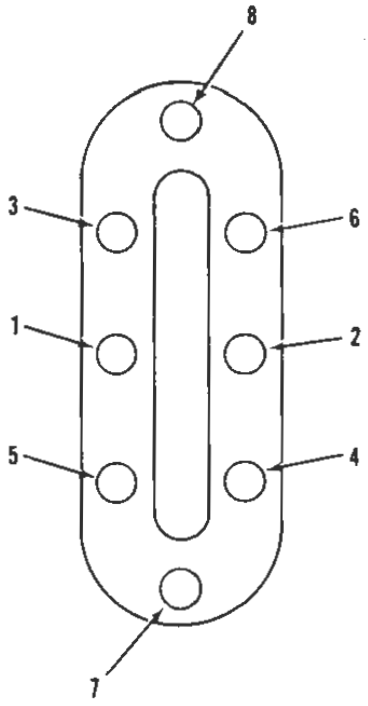
*NOT REMOVED AT MAINTENANCE LEVEL

Oil Tank Installation
Figure 204

R 1. D. (2) (e) Tighten screws (150) in increments of five inch-
R pounds each, in sequence illustrated in Figure
R 205. Continue tightening screws in five inch-
R pound increments until a final torque of 40 inch-
R pounds is obtained on all screws. Ensure compound
R is not visible on lens of liquid level gage after
R final torquing sequence.

(f) Seal oil tank ports and pressurize oil tank at five psig. Immerse oil tank in water and observe that no air leakage occurs at retainer and lens. If leakage occurs, remove retainer and lens components from oil tank and repeat steps (a) through (f) until satisfactory assembly is obtained which does not leak.

R



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R Sequence for Tightening Screws
R Securing Liquid Level Gage
R Figure 205

J. D. (3) Install filler plug with new packing on oil tank.

(4) Insert mounting strip within mating bracket on oil tank. When using mounting strip without end flanges for handling, hold mounting strip in position with bolt holes aligned using small piece of tape at each end of mounting strip.

(5) Position oil tank on engine and secure with mounting strip and screws. If installed, remove tape on mounting strip. Tighten screws or bolts (50, 70) to torque of 40 inch-pounds.

(6) Install upper and lower mount links and secure with nuts, bolts, bushings, and washers. Tighten bolts (5) to torque of 25 inch-pounds. Tighten nuts (15) to torque of 20 inch-pounds.

E. Install Vent and Filler Tube Installation (See Figure 203)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Install new packing on gage or plug and install gage or plug on filler tube. Install new packing on end of filler tube which mates with oil tank. Install clamp on filler tube and position filler tube on engine.

(2) (Code A) On engines utilizing long grounding cable (approximately 20 inches), install clamp on cable and align with clamp installed on filler tube.

NOTE: (Code B) Washer (75) is utilized only when required to locate gage at aircraft station number 194.81.

1. E. (3) Secure filler tube to fan inlet housing and oil tank with nuts, washers, retainer, and bolts. Tighten nuts (65, 95) to torque of 40 inch-pounds. Tighten bolt (130) to torque of 70 inch-pounds.

(4) Assemble vent tube and elbow with new packings and secure to engine with bolts and retainers. Tighten bolts (5, 15) to torque of 25 inch-pounds.

(5) On vent tube utilizing plug, install plug with new packing in vent tube. Tighten plug (45) to torque of 35 inch-pounds.

F. (Codes A, B) Assemble Tank-to-Pump Tubes (See Figure 201)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Install clamps on tubes.

(2) Assemble tubes, elbow, and adapter with new packings. Secure elbow to oil pump with nuts and washers. Secure adapter to oil pump with bolts and washers. Secure scavenge tube and oil tube with nuts, washers, bolts, lockplates, and retainers. Tighten nuts (50) to torque of 20 inch-pounds. Tighten bolts (120) to torque of 25 inch-pounds. Tighten bolts (75, 145) to torque of 25 inch-pounds. Tighten bolts (95) to torque of 70 inch-pounds.

(3) On units utilizing bracket (20), secure clamps on tubes to bracket with nuts and bolts. Tighten bolts (5) to torque of 25 inch-pounds.

(4) On units utilizing bracket (45), remove right-hand nut securing oil filter components to accessory drive gearbox. Install bracket over stud and reinstall nut to secure bracket. Secure clamp on oil tube to bracket with nut and bolt. Tighten bolt (5) to torque of 25 inch-pounds. Secure scavenge tube to oil pressure sensing tube assembly with clamps, nut, and bolt. Tighten bolt (5) to torque of 25 inch-pounds.

1. F. (5) (Code A (Series 35 and Subq), Code B (Series 20 and Subq), Code C) Install bracket at aft end of oil pump with nuts, bolt, and clamp to secure cooler-to-lube jets tube assembly in accordance with 79-20-07, MAINTENANCE PRACTICES.

G. (Code C) Assemble Tank-to-Pump Tubes (See Figure 202)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Assemble tubes and adapter with new packings. Secure adapter to oil pump with bolts and washers. Secure oil tube to adapter and oil tank with nuts, washers, lock plates, and bolts. Secure scavenge tube to oil pump and oil tank with nuts, washers, lock plates, and bolts. Tighten nuts (40) to torque of 20 inch-pounds. Tighten bolts (50) to torque of 70 inch-pounds. Tighten bolts (110, 140) to torque of 25 inch-pounds.

(2) Install bracket to support scavenge tube at valve mounting flange of fuel/oil cooler. Tighten bolt (25) to secure bracket to torque of 50 inch-pounds. Secure scavenge tube to bracket with nut, bolt, and clamp. Tighten bolt (10) to torque of 25 inch-pounds.

(3) Install bracket to support oil tube at right-hand stud for securing oil filter components. Install washer under bracket to obtain required bracket position. Tighten nut to secure bracket to torque of 40 inch-pounds. Secure oil tube to bracket with nut, bolt, and clamp. Tighten bolt (85) to torque of 25 inch-pounds.

(4) Install bracket at aft end of oil pump with nuts, bolt, and clamp to secure cooler-to-lube jet tube assembly in accordance with 79-20-07, MAINTENANCE PRACTICES.

2. Inspection/Check

A. Inspect Tubes and Elbows

(1) Inspect for corrosion, cracks, dents which cause a crease or reduce diameter more than ten percent, and evidence of leakage.

(2) Replace tubes or elbows if corrosion, cracks, dents which cause a crease or reduce diameter more than ten percent, or leakage is evident.

2. B. Inspect Oil Tank

R (1) Visually inspect for cracks, cracked welds, damaged
R sealing surface on filler neck and cracked support
R brackets.

(2) Inspect bosses for stripped threads and broken welds.

R (3) Inspect tank for evidence of leakage.

R (4) Replace oil tank not meeting inspection requirements of
R steps (1) through (3).

(5) (Code C) Invert oil tank while listening for audible indication of movement of internal ball valve. If ball valve movement is not heard, replace oil tank.

3. Clean/Painting

A. Clean Parts

Clean parts as specified in Table 203 in accordance with cleaning methods provided in 72-00-00, GENERAL - CLEANING/PAINTING.

Table 203. Cleaning Methods

Figure No.	Index No.	Nomenclature	Cleaning Methods 1	2	3	4	5	6	7	8	9	10	11	12
All standard metallic hardware			X	X										
Plumbing and fittings											X			
204	40	Upper Mount Link	X	X							X			
	45	Lower Mount Link	X	X							X			
	47	Mount Link Bushing	X	X							X			
	90, 95, 100, or 102	Tank Mounting Strip	X	X			X	X						

DISTRIBUTION - DESCRIPTION AND OPERATION

1. Oil Filter and Cover

The oil filter and its metal housing are mounted on the right hand side on the aft face of the accessory drive gearbox. The oil filter element is a disposable 15 micron nominal (25 micron absolute) filter element enclosed in a cover and functions to filter all oil entering the engine. A cap which threads onto the oil filter cover allows for removal of the filter element without removal of the entire filter cover.

2. Breather Pressurizing Valve

The valve is mounted on the aft face of the accessory gearbox between the oil pump and the fuel pump. It is an evacuated bellows operated device whose function is to control the accessory drive gearbox absolute pressure by restricting airflow. The gearbox pressure is maintained at ambient to approximately 30,000 feet altitude and is above ambient from 30,000 to 50,000 feet altitude.

3. Lube and Scavenge Oil Pump

The lube and scavenge oil pump is mounted on the accessory drive gearbox and contains the oil pressure pump and four scavenge pumps. These pumps scavenge oil from the following: (1) the planet gear assembly and forward-engine bearings, (2) the aft-engine bearing, (3) the transfer gearbox and the mid-engine bearings (through the tower shaft housing), and (4) the accessory drive gearbox. The discharge side of all scavenge pumps connects to a common line that is routed to the oil tank. The oil pump provides mounting for the chip detector and the fan gearbox scavenge oil temperature probe. An adjustable pressure regulator is contained in the oil pump to maintain oil pressure within desired operating limits. Regulation is with respect to pressure of the oil delivered to the planet gear assembly.

The capacity of the scavenge pumps is greater than that of the pressure pump to assure good scavenge performance.

4. Rear Turbine Bearing Oil Lines

The rear turbine bearing oil tubes are externally mounted tubes which connect the oil supply to the rear turbine bearing and return scavenge oil from the bearing to the scavenge pump.

5. Fuel Heater Installation (Codes A, C)

The fuel heater is externally mounted on the left side of the engine. Hot oil from the oil filter mounted on the accessory drive gearbox is routed through the fuel heater before entering the air oil coolers. Fuel is routed through the fuel heater

when required by the fuel pump for fuel filter anti-icing. A bypass valve is provided to bypass oil around the heat exchanger within the fuel heater in the event of clogging or congealed oil in the heat exchanger.

6. Oil Temperature Regulator (Fuel/Oil Cooler) Installation

The fuel/oil cooler is externally mounted on the right side of the engine. Oil that has passed through the air oil coolers is further cooler by fuel routed directly to the fuel/oil cooler from the fuel control. A thermostatic and pressure bypass valve is provided in the oil side to regulate oil temperature and bypass oil around the heat exchanger of the fuel/oil cooler in the event of clogging or congealed oil in the heat exchanger.

7. Oil (Air/Oil) Cooler Installation

The surface oil (air/oil) cooler installation is a three-segment, finned cooler that forms the inner surface of the engine fan duct. The coolers are inter-connected by oil transfer tubes, fittings and a temperature control valve. Oil flow through the air/oil coolers is controlled by the temperature control valve to aid maintaining proper oil temperature.

OIL FILTER AND COVER INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove and Install Oil Filter

(1) Remove oil filter as follows (See figure 201.)

(a) (Codes A, B) Remove oil filter cap and packing from oil filter cover.

(b) (Code C) Unthread bushing and remove bushing, cap, and packing.

(c) Remove filter from accessory drive gearbox. If same filter is to be re-installed, inspect packing (in place) in forward end of filter. Do not remove packing from forward end of filter unless damage is evident.

(2) Install oil filter as follows. (See figure 201.)

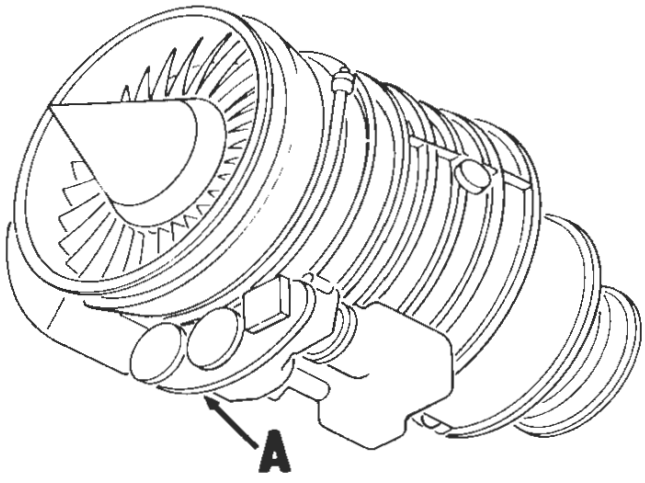
NOTE: Small diameter packing at forward end of oil filter is included as part of new filter.

(a) If filter previously removed is to be reinstalled and packing at forward end of filter has been removed for damage, apply a light coat of engine oil and install new packing in end of filter. If installing filter with packing at forward end of filter in place, apply a light coat of engine oil to internal diameter of packing without removing packing.

(b) Install filter, seating it firmly on tube in accessory drive gearbox.

(c) Apply a light coat of engine oil to new packing (for cap or bushing, as applicable) and install packing either over threads of cover or in packing groove of cap, as applicable.

(d) (Codes A, B) Apply a light coat of engine lubricating oil to threads of cap and thread cap onto oil filter cover. Hand tighten cap to shoulder of cover. Do not tighten cap with wrench. Secure cap with lockwire.



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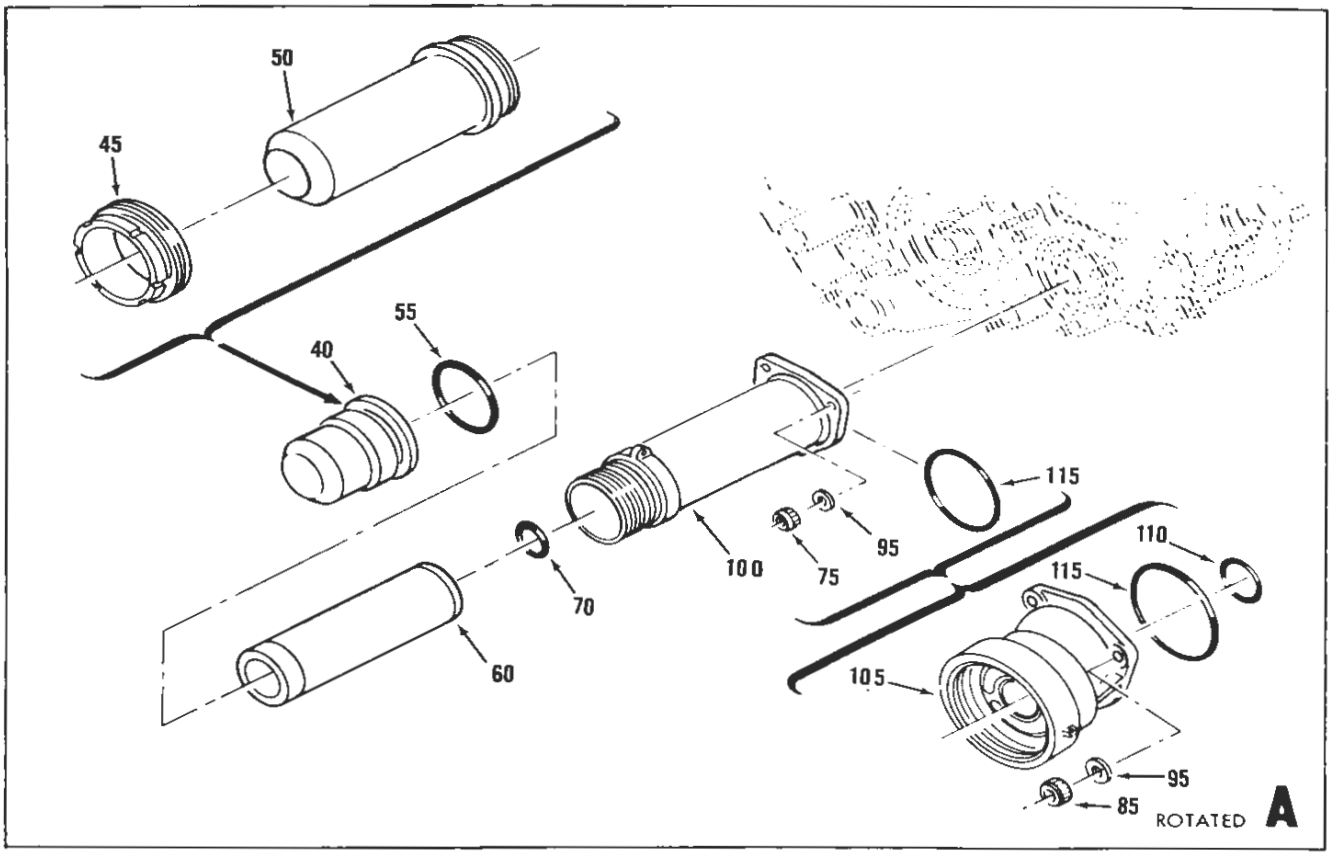

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R Oil Filter and Cover Installation
Figure 201

1. A. (2) (c) (Code C) Apply a light coat of engine lubricating oil to threads of bushing. Install cap over filter and secure by threading bushing into adapter hand-tight. Do not tighten bushing with wrench. Secure bushing with lockwire.

B. Remove and Install Oil Filter Cover or Adapter

NOTE: The cap on the oil filter cover or adapter permits removal of oil filter without removal of entire cover or adapter.

Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Remove oil filter cover or adapter as follows. (See figure 201.)

(a) (Codes A, B) Remove nuts and washers. Remove cover and packing.

(b) (Code C) Remove nuts and washers. Remove adapter and packings.

(2) Install oil filter cover or adapter. (See figure 201.)

(a) (Codes A, B) Install new packing in groove in cover. Install cover with holes in flange over studs on accessory drive gearbox.

(b) (Code C) Install new packings on adapter. Install adapter over studs on accessory drive gearbox.

R (c) Install washers and nuts (75 or 85) on studs and torque to 40 inch-pounds.

KEY TO FIGURE 201

R 40.	CAP (CODES A, B)	75.	NUT (CODES A, B)
R	(IPC FIG. 65)	85.	NUT (CODE C)
R 45.	BUSHING (CODE C)	95.	WASHER (CODES A, B)
R 50.	CAP (CODE C)	100.	COVER (CODES A, B)
R 55.	PACKING	105.	ADAPTER (CODE C)
R 60.	FILTER	110.	PACKING (CODE C)
R 70.	PACKING	115.	PACKING (CODES A, B)

2. Inspection/Check

A. Inspect Oil Filter

R (1) Visually inspect oil filter for contamination.
R If any metal chips are visible through oil
R filter mesh, check condition of oil system in
R accordance with 72-00-00, TROUBLE SHOOTING,
R paragraph 1.J.

(2) Visually inspect for cracks or breaks in outer shell.

(3) Replace damaged or contaminated filter.

3. Cleaning/Painting

A. Clean Parts

Clean parts as specified in Table 202 in accordance with cleaning methods provided in 72-00-00, GENERAL - CLEANING/1.PAINTING.

Table 202. Cleaning Methods

Figure No.	Index No.	Nomencature	Cleaning Methods 1 2 3 4 5 6 7 8 9 10 11 12
All standard metallic hardware			X X
201	1	Cap	X X X X
	2	Bushing	X X X X
	3	Cap	X X X X
	10	Cover	X X X X
	14	Adapter	X X X X

R

BREATHER PRESSURIZING VALVE INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Special Tools, Fixtures and Equipment

Item No.	Nomenclature	Use	Part No.
NOTE: Equivalent substitutes may be used for listed items.			
1.	Installation Seal Driver	Installs seal.	289801-1
2.	Seal Removal Puller Set	Remove seal.	289808-1

A. Remove Breather Pressurizing valve (See Figure 201)

(1) Remove nuts, washers and valve from accessory drive gearbox.

(2) Remove packing from valve.

(3) Do not remove seal from valve unless damage is indicated at inspection. If required, remove seal using 289808-1 puller set.

B. Install Breather Pressuring Valve (See Figure 201)

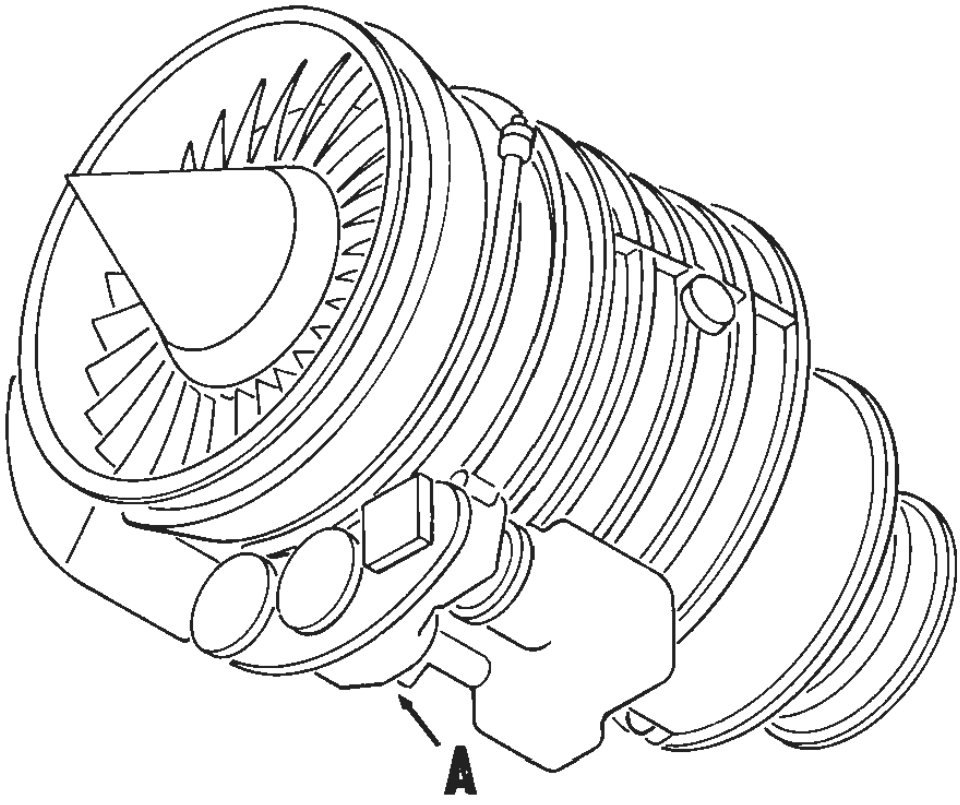
CAUTION: USE CARE TO PREVENT DAMAGE TO THE LIP OF SEAL DURING ASSEMBLY.

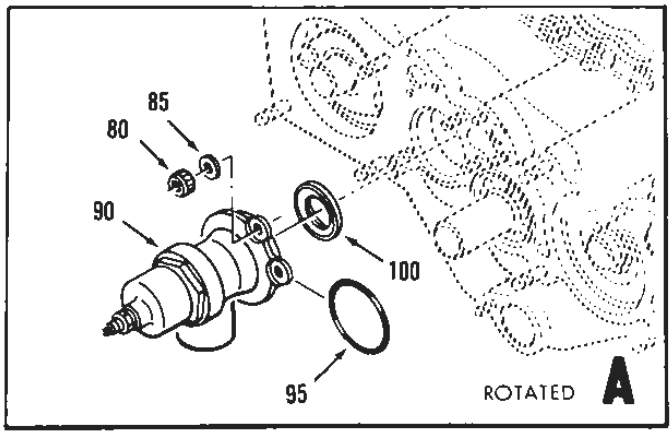
NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Install, if removed, new seal in the end of removed or replacement valve using 289801-1 seal driver. (See figure 202.) The closed side of the seal shell must face outward from valve.

(2) Install new packing in groove on valve.

R





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R 80. NUT (IPC FIG. 65)
R 85. WASHER
R 90. VALVE
95. PACKING
100. SEAL

R Breather Pressurizing Valve Installation
Figure 201

1. B. (3) Position valve on accessory drive gearbox with flange holes over studs and secure with washers and nuts.
R Tighten nuts (80) to torque of 30 inch-pounds.

2. Inspection/Check

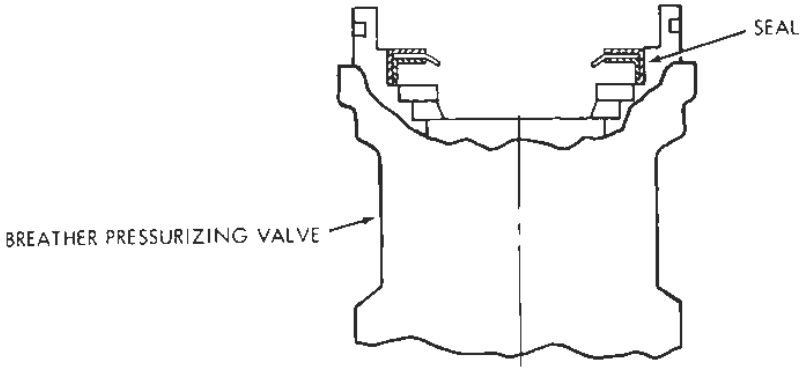
A. Inspect Breather Pressurizing Valve

(1) Visually inspect valve for obvious damage.

(2) Check valve for open position and condition of bellows by holding valve in light source and looking into end of valve. Defective bellows will cause valve to be in closed position. (Nominal opening for a functional valve is 0.070 to 0.075 inch.)

(3) Inspect seal for damage.

(4) Replace breather pressurizing valve or seal if inspection requirements in steps (1) through (3) are not met.



Seal Installation
Figure 202

3. Cleaning/Painting

A. Clean Parts

Clean nuts and washers in accordance with 72-00-00, GENERAL-CLEANING/PAINTING, Cleaning Method 1 or 2.

OIL PUMP AND CHIP DETECTOR INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Special Tools, Fixtures and Equipment

Item No.	Nomenclature	Use	Part No.
NOTE:	Equivalent substitutes may be used for listed items.		
1.	Oil Tube Mechanical Puller	Removes scavenge tube from oil pump.	289770-2
2.	Oil Tube Extractor	Removes transfer tubes from oil pump.	293301-1

A. Remove Lube and Scavenge Oil Pump (See Figure 201)

R NOTE: When only inspecting for presence of magnetic
R particles on magnetic plug of chip detector,
R remove only magnetic plug. Refer to step (14)
R and Figure 201A or 201B.

(1) (Codes A, B) Disconnect electrical connector from magnetic plug (chip detector).

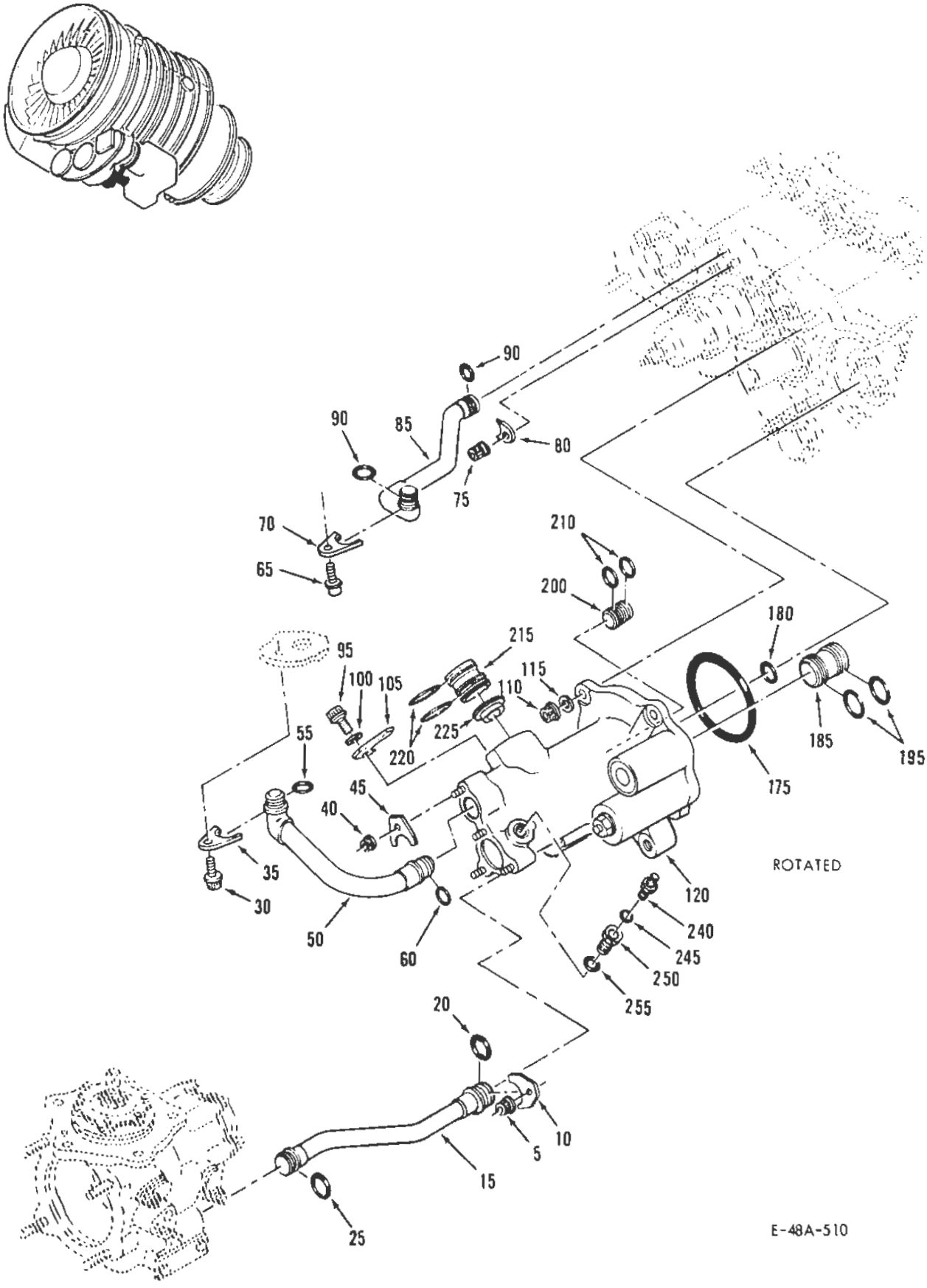
(2) (Codes A (Series 35 and subq), B (Series 20 and subq), C) If installed, remove nuts, bolt, clamp, and bracket securing cooler-to-lube jets tube assembly at aft end of oil pump in accordance with 79-20-07, MAINTENANCE PRACTICES.

(3) Remove oil tubes to oil pump from oil tank in accordance with 79-10-01, MAINTENANCE PRACTICES.

(4) Remove oil pressure sense tube assembly in accordance with 79-20-07, MAINTENANCE PRACTICES.

(5) Remove nut, bolt, and retainers securing scavenge tube at aft end of oil pump and remove scavenge tube. Remove packings from scavenge tube.

(6) Remove bolt, washer, and retainer securing scavenge tube on side of oil pump. Using 289770-2 puller, push scavenge tube into bottom duct rib to disengage oil pump.



Oil Pump and Chip Detector Installation
Figure 201

1. A. (7) Remove nut and retainer securing scavenge tube from transfer gearbox to oil pump. Slide scavenge tube into transfer gearbox to disengage oil pump, then remove scavenge tube. Remove packings from scavenge tube.

(8) Remove nuts and washers securing oil pump to gearbox and remove oil pump.

(9) (Code C) Remove screen from boss on side of oil pump.

(10) Remove packings from shaft and flange of oil pump.

(11) Remove nut and retainer securing vent tube at aft face of accessory drive gearbox. Remove bolts and retainers securing vent tube to bottom duct rib. Remove vent tube, then remove packings from vent tube.

(12) Remove scavenge tube from bottom duct rib with 289770-2 puller. Remove packings from scavenge tube.

(13) Remove transfer tubes from base of oil pump using 293301-1 extractor. Remove packings from transfer tubes.

R (14) When removing assembled chip detector (magnetic plug installed in check valve housing), remove by wrenching on wrench flats of check valve housing then remove magnetic plug and packings. To remove only magnetic plug of chip detector, use second wrench to hold check valve housing stationary and remove magnetic plug and packing on magnetic plug.

KEY TO FIGURE 201

5.	NUT (IPC FIG. 49)	70.	TUBE RETAINER	195.	PACKING
10.	TUBE RETAINER	75.	NUT	200.	TRANSFER TUBE
15.	SCAVENGE TUBE	80.	TUBE RETAINER	210.	PACKING
20.	PACKING	85.	VENT TUBE	215.	SCAVENGE TUBE
25.	PACKING	90.	PACKING	220.	PACKING
30.	BOLT	95.	BOLT	225.	SCREEN (CODE C)
35.	TUBE RETAINER	100.	WASHER	240.	MAGNETIC PLUG OF CHIP DETECTOR
40.	NUT	105.	TUBE RETAINER	245.	PACKING
45.	TUBE RETAINER	110.	NUT	250.	CHECK VALVE HOUSING OF CHIP DETECTOR
50.	SCAVENGE TUBE	115.	WASHER	255.	PACKING
R 55.	PACKING	120.	OIL PUMP		
R 60.	PACKING	175.	PACKING		
R 65.	BOLT	180.	PACKING		
		185.	TRANSFER TUBE		

1. B. Install Lube and Scavenge Oil Pump (See Figure 201)

CAUTION: IF PROPER CARE IS NOT TAKEN DURING INSTALLATION OF OIL PUMP AND ASSOCIATED PARTS, OIL LEAKAGE MAY RESULT. CLEAN ALL SURFACES (THREE PLACES) WITHIN ACCESSORY DRIVE GEARBOX WHICH MATE WITH PACKINGS INSTALLED WITH OIL PUMP TO ENSURE SEALING SURFACES ARE FREE OF OIL PACKING MATERIAL. USE ALL NEW PACKINGS (FIGURE 201) AT INSTALLATION. INSPECT NEW PACKINGS TO ENSURE THERE IS NO EXCESSIVE MOLD LINE FLASH. IF EXCESSIVE MOLD LINE FLASH EXISTS, CAREFULLY DRESS OFF PACKING. LUBRICATE PACKINGS BEFORE INSTALLATION TO AID ASSEMBLY. WHEN INSTALLATING OIL PUMP ON ACCESSORY DRIVE GEARBOX, USE CARE IN POSITIONING OIL PUMP AND TRANSFER TUBES TO AVOID CUTTING PACKINGS. VERIFY THAT WHEN OIL PUMP IS INSTALLED, OIL PUMP FLANGE IS FULLY SEATED AGAINST ACCESSORY DRIVE GEARBOX MOUNTING PAD SURFACE. EXERCISE CARE WHEN TAPPING ON OIL PUMP MAGNESIUM HOUSING TO AVOID DAMAGING HOUSING. AFTER COMPLETION OF ENGINE ASSEMBLY AND OPERATING ENGINE TO CHECK FOR OIL LEAKS, VERIFY TORQUE ON NUTS SECURING OIL PUMP TO ACCESSORY DRIVE GEARBOX IS 60 INCH-POUNDS.

R DO NOT EXCEED SPECIFIED TORQUE VALUES ON CHIP
R DETECTOR COMPONENTS. EXCESSIVE TORQUE WILL DAMAGE
R CHIP DETECTOR AND/OR OIL PUMP HOUSING.

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

R When only magnetic plug of chip detector has been
R removed and check valve housing of chip detector has
R remained installed in oil pump, install magnetic plug
R with new packing as specified in step 1.B.(8). Refer
R to Figure 201A or 201B.

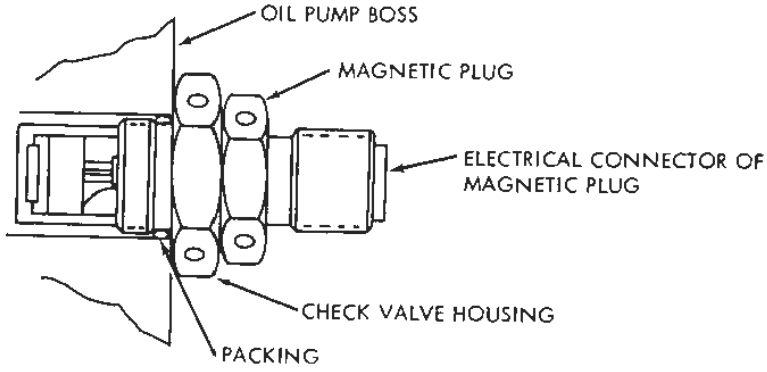
(1) Install new packings on transfer tubes. Install transfer tubes in gearbox.

(2) Install new packings on oil pump shaft and flange.

(3) Install new packings on scavenge tubes. Insert short scavenge tube into bottom duct rib.

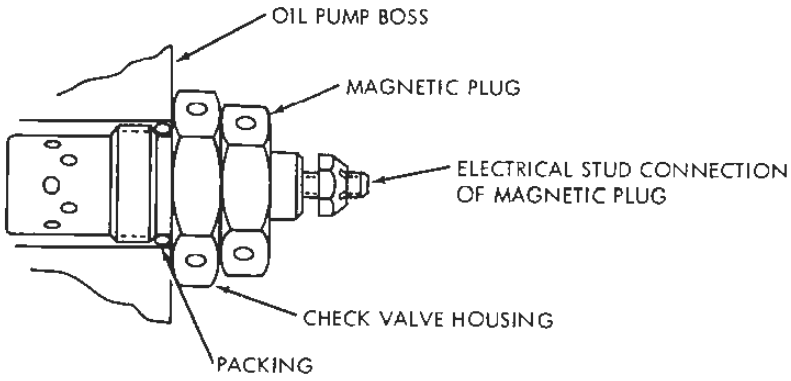
(4) Install new packings on vent tube and install vent tube. Install retainers and bolts securing vent tube to bottom duct rib. Install retainer and nut to aft face of accessory drive gearbox. Tighten nut (75) to torque of 27 inch-pound. Tighten bolts (65) to torque of 25 inch-pounds.

R



R (Codes A, B) Identification of Electrical
R Chip Detector Components
R Figure 201A

R



R
R
R

(Code C) Identification of Electrical Chip Detector Components
Figure 201B

1. B. (5) (Code C) Install screen into boss on side of oil pump.

(6) Position oil pump on accessory drive gearbox studs, then secure with washers and nuts. Tighten nuts (110) to torque of 60 inch-pounds.

(7) Pull short scavenge tube into oil pump using 289770-2 puller. Install scavenge tubes, then secure to oil pump with retainers, nuts, washers, and bolts. Tighten bolts (30) to torque of 25 inch-pounds. Tighten nut (40) to torque of 20 inch-pounds. Tighten bolt (95) to torque of 20 to 25 inch-pounds. Tighten nuts (5) to torque of 27 inch-pounds.

R CAUTION: DO NOT EXCEED SPECIFIED TORQUE VALUES
R ON CHIP DETECTOR COMPONENTS. EXCES-
R SIVE TORQUE WILL DAMAGE CHIP DETECTOR
R AND/OR OIL PUMP HOUSING.

R (8) When installing only magnetic plug of chip detector
R (check valve housing not removed from oil pump): As-
R semble magnetic plug with new packing in check valve
R housing, using a second wrench to hold check valve
R housing stationary; tighten magnetic plug (240) to 35
R to 40 inch-pounds torque. When installing both mag-
R netic plug and check valve housing of chip detector:
R assemble magnetic plug of chip detector in check valve
R housing with new packing; tighten magnetic plug (240)
R to 35 to 40 inch-pounds torque; install assembled parts
R in oil pump with new packing installed on check valve
R housing; tighten check valve housing (250) to 95 to 100
R inch-pounds torque. Do not exceed torque specified.

(9) (Codes A, B) Connect electrical connector to chip detector in accordance with Aircraft Maintenance Manual.

(10) Install oil tubes from oil tank to oil pump in accordance with 79-10-01, MAINTENANCE PRACTICES.

(11) Install oil pressure sensing tube assembly in accordance with 79-20-07, MAINTENANCE PRACTICES.

(12) (Codes A (Series 35 and subq), Code B (Series 20 and subq), Code C) If removed at disassembly, install nuts, bolt, clamp, and bracket securing cooler-to-lube jets tube assembly at aft end of oil pump in accordance with 79-20-07, MAINTENANCE PRACTICES.

WARNING: AREAS IN PROXIMITY OF ENGINE INLET AND EXHAUST AREAS ARE EXTREMELY HAZARDOUS TO PERSONNEL WHEN ENGINE IS OPERATING. PERSONNEL SHALL CLEAR THESE AREAS DURING ENGINE START AND OPERATION TO AVOID INJURY.

1. B. (13) Operate engine in accordance with Aircraft Maintenance Manual to ensure no oil leakage. After shutting down engine, recheck that torque on nuts securing oil pump to accessory drive gearbox is 60 inch-pounds.

2. Inspection/Check

A. Inspect Lube and Scavenge Oil Pump

(1) Inspect shaft for wear or distortion.

(2) Inspect transfer tubes for cracks or distortion.

(3) Inspect scavenge and vent tubes for cracks or distortion.

(4) Inspect pump for apparent damage.

NOTE: If pump is replaced, ensure magnetic plug (chip detector), plug housing, and associated packings are removed.

(5) Replace pump or tubes if inspection requirements in steps (1) through (4) are not met.

(6) Inspect chip detector.

R (a) Check magnetic plug and check valve housing for
R cracks, stripped threads, or other damage.

R (b) Check for proper operation of valve within check
R valve housing as follows.

R 1) Stroke valve fully open using eraser-end of
R pencil (or other suitable device), then allow
R valve to fully close. Valve shall stroke
R fully open and return to fuly closed position
R with no binding or sticking evident. Valve
R shall fully seat to prevent any oil leakage
R when closed. If any metal chips are visible
R within check valve housing, flush housing with
R solvent, Stoddard (Federal Specification P-D-
R 680, Type I) to completely remove chips.

R 2) Repeat step 1) nine additional times.

R 2. A. (6) (c) Ensure probe end of magnetic plug is clean. Measure resistance from electrical connection of magnetic plug to metal case of magnetic plug with multimeter using RX10K ohmmeter scale. Resistance shall be greater than 250K ohms. (Low resistance may be caused by contaminated electrical connector on magnetic plug. If resistance is low, thoroughly flush electrical connector with solvent, trichlorotrifluoroethane (MS-180 Freon) and repeat resistance check.)

(d) Connect electrical short across metal case of magnetic plug and center electrode at probe-end of magnetic plug. There shall be continuity from electrical connector on magnetic plug to metal case of magnetic plug.

(e) Replace chip detector (magnetic plug and check valve housing) if inspection requirements are not met.

(7) Inspect oil pump housing for damaged paint and corrosion. Refer to 3, Cleaning/Painting for touchup of damaged paint where no corrosion is evident. Refer to 4, Approved Repairs for repair of corrosion damage.

3. Cleaning/Painting

Table 202. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
Abrasive paper (Federal Specification P-P-101)	Commercially available
R Color coat (A423-66 Enamel R No. 051 and C1178 Catalyst) R	Griggs Paint, Subsidiary of Domcom Dist, 3602 S 16th Place, Phoenix, AZ 85040
R Primer (P-415-66-611B R and Catalyst C1178-66) R	Griggs Paint, Subsidiary of Domcom Dist, 3602 S 16th Place, Phoenix, AZ 85040
R Solvent, Stoddard R (Federal Specification R P-D-680, Type I) R	Commercially available

R Table 202. Materials and Compounds (Cont)
R

R Material or Compound	Manufacturer
R Solvent, Trichloro-trifluoroethane (MS-180 Freon)	Miller-Stephenson Chemical Co, Inc, P.O. Box 628, Danbury, CT 06810

3. A. Clean Parts

CAUTION: METHANOL (METHYL OR WOOD ALCOHOL) SHALL NOT BE USED AS A CLEANING AGENT WHEN CLEANING MAGNESIUM HOUSING OF OIL PUMP. PROLONGED CONTACT OF METHANOL WITH UNPROTECTED MAGNESIUM COMPONENT WILL DESTROY COMPONENT. USE OF METHANOL WITH MAGNESIUM COMPONENTS IS AUTHORIZED ONLY AS SPECIFICALLY INSTRUCTED FOR REPAIR OF CORRODED SURFACES.

Clean all standard metallic hardware in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method 1 or 2. Clean plumbing and fittings in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method 12.

R Thoroughly clean electrical connector on magnetic plug of chip detector using solvent, trichlorotrifluoroethane (MS-180 Freon). Thoroughly clean body of magnetic plug and check valve housing of chip detector using solvent, Stoddard (Federal Specification P-D-680, Type I).

B. Touch Up Damaged Paint on Non-Corroded Surfaces of Oil Pump Housing

(1) Treat any exposed base metal (magnesium) in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method 7.

(2) Touch up bare metal on surfaces with wipe coat of primer (P-415-66-611B and Catalyst C1178-66) as follows.

R (a) Prepare primer by mixing in equal parts by volume. Allow mixed primer to stand for 30 minutes before application.

3. B. (2) (b) Apply primer, then wipe primer while wet to prevent buildup.

(c) Air-dry primer for 15 to 30 minutes, then heat-cure with portable hot air gun for one hour at temperature of 80 to 107C (175 to 225F).

(3) Touch up bare metal on surfaces with full coat of
R primer (P-415-66-611B and Catalyst C1178-66) as
R follows.

R (a) Prepare primer by mixing in equal parts by volume. Allow mixed primer to stand for 30 minutes before application.

(b) Apply one coat of primer by brushing or spraying.

(c) Air-dry primer for 15 to 30 minutes, then heat-cure with portable hot air gun for one hour at temperature of 80 to 107C (175 to 225F).

R (4) Touch up damaged color coat (A423-66 Enamel No. 051 and
R C1178 Catalyst) as follows.

(a) Remove damaged paint and blend edges of damaged paint areas with abrasive paper (Federal Specification P-P-101).

(b) Treat any exposed base metal (magnesium) in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method 7.

(c) Apply primer as specified in step (3) to a thickness of one mil.

R (d) Prepare color coat by mixing Catalyst A423-66
R Enamel No. 051 and C1178 Catalyst in equal parts by volume. Allow mixed color coat to stand for 30 minutes before application.

(e) Apply one coat of color coat two to three mils thick by either brushing or spraying.

(f) Air-dry color coat for 15 to 30 minutes, then heat-cure with portable hot air gun for one hour at temperature of 80 to 107C (175 to 225F).

4. Approved Repairs

Table 203. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
R Color coat (A423-66 Enamel R No. 051 and C1178 Catalyst) R	Griggs Paint, Subsidiary of Domcom Dist, 3602 S 16th Place, Phoenix, AZ 85040
Grease (Braycote 248)	Bray Oil Co, 1925 N Marianna Ave, Los Angeles, CA 90063
Methanol (methyl or wood alcohol)	Commercially available
No. 400 wet or dry abrasive	Commercially available
No. 600 wet or dry abrasive	Commercially available
R Primer (P-415-66-611B R and Catalyst C1178-66) R	Griggs Paint, Subsidiary of Domcom Dist, 3602 S 16th Place, Phoenix, AZ 85040
Protective coating (Clear Coat V92VC10)	Sherwin-Williams Co, Main Store, 2312 N 16th St, Phoenix, AZ 85006
Sandpaper (210 grit size)	Commercially available
Solvent, Stoddard (Federal Specification P-D-680, Type I)	Commercially available
*Touch-up solution (Dow 1)	Dow Corning Corp, S Saginaw Rd, Midland, MI 48640
**Touch-up solution (Dow 19)	Dow Corning Corp, S Saginaw Rd, Midland, MI 48640

NOTE: *Touch-up solution (Dow 1) may be mixed from commercially available chemicals (sodium dichromate and nitric acid) as described in repair procedures.

**Touch-up solution (Dow 19) may be mixed from commercially available chemicals (chromic acid flake and calcium sulfate as described in repair procedures.

4. A. (Oil Pumps, Part Nos. 3071432-5, 3071949-1, or 3071949-2)
R Repair Sticking Oil Pump Pressure Regulator (See Figure
R 202)

R (1) Remove pressure regulator components as follows.

(a) Loosen and remove locknut, then remove retaining washer.

(b) Rotate adjusting stud counterclockwise until stop is reached.

(c) Remove top spiral retainer.

CAUTION: AVOID SCRATCHING OR DAMAGING PUMP HOUSING WHEN PRYING OR FORCING PARTS DURING DISASSEMBLY.

(d) Pull out assembed key washer, top retainer plate, packing, and adjusting stud assembly. Assembled parts are under slight spring load from calibration spring. If required for removal, thread locknut onto adjusting stud and pry against locknut. Remove packings from top retainer plate and adjusting stud assembly.

(e) Remove calibration spring.

(f) On units without internal threads on stem, use finger pressure to pull out assembled stem, pistons, and pressure sensing housing. If necessary to initially unseat parts, pry on bypass valve sleeve from opposite end of bore to force bypass valve sleeve toward open (top) end of bore approximately one-eighth inch.

(g) On units with internal threads on stem, thread a piece of 8-32 threaded rod into stem and pull assembled stem, pistons, and pressure sensing housing from open (top) end of bore.

(h) Use scribe or other suitable tool to unseat packing which seats between pressure sensing housing and bypass valve sleeve, then remove packing.

(i) If oil pump has been removed from engine, remove bottom spiral retainer and force bypass valve sleeve with assembled packing out bottom of bore. If oil pump is installed on engine, force bypass valve sleeve with packing out open end of bore by prying from opposite side.

4. A. (1) (j) Remove screw and washer in upper bore of housing. Remove spiral retainer. Assembled parts are under slight spring load.

(k) Remove plate, packing and spring. Use finger pressure to pull out poppet and sleeve.

(2) Check fit of smaller outside diameter of pressure sensing housing with mating surface of bypass valve sleeve. Parts shall fit freely along complete length of mating surfaces and when parts are rotated with respect to each other. If any binding is noted, rework part as follows.

(a) Using arbor press, press stem through bypass valve pistons to release C-washer and remove C-washer. Relax force and remove bypass valve pistons and, if installed, remove shims. Remove spring, pressure sensing housing, packing, and pressure sensing piston from stem.

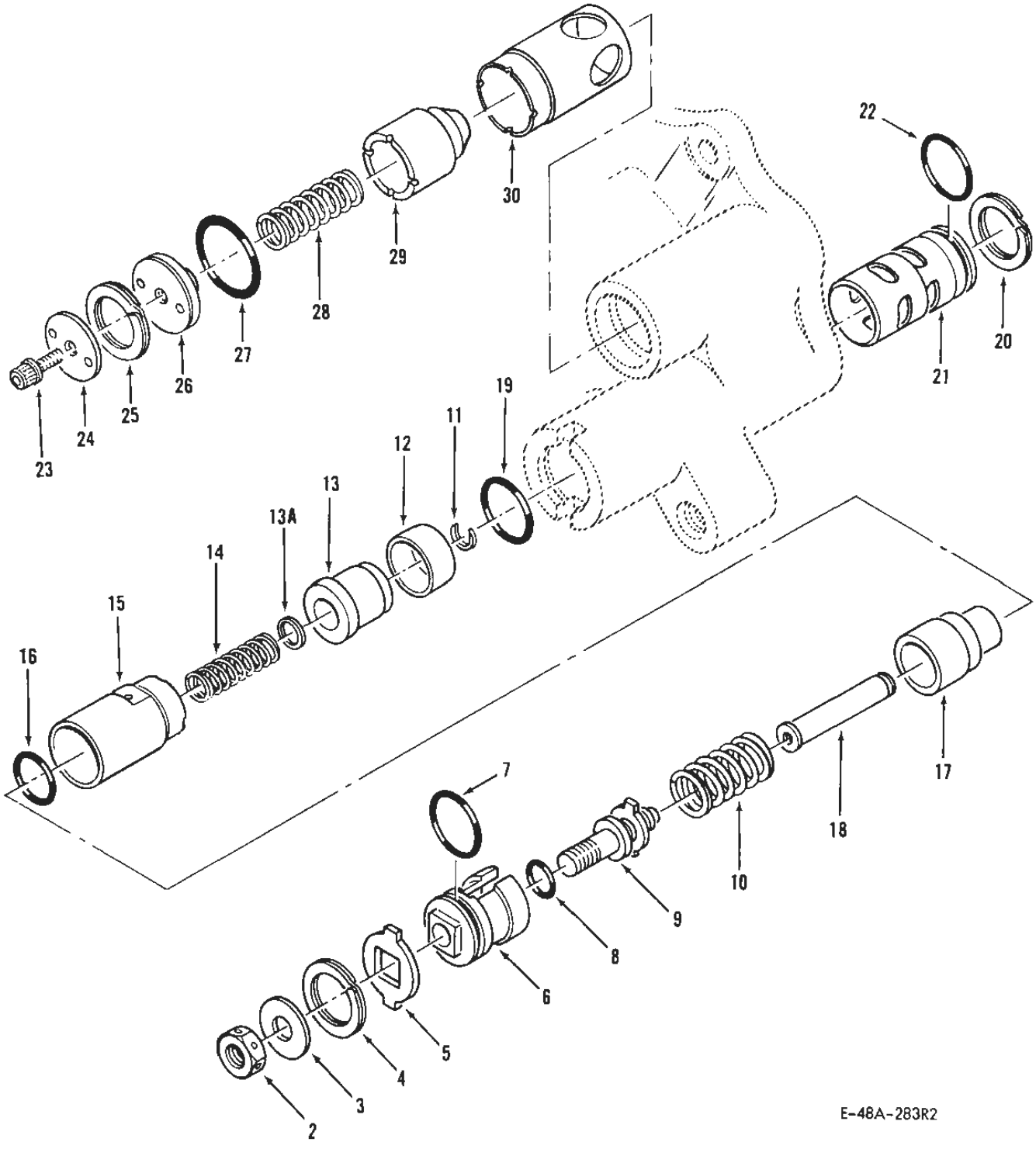
(b) Thoroughly clean parts in solvent, Stoddard (Federal Specification P-D-680, Type I).

(c) Dress mating surfaces of pressure sensing housing and bypass valve sleeve with No. 400 wet or dry abrasive to obtain free fit without binding. Do not expose base metal through hard-anodize finish. Thoroughly clean parts in solvent, Stoddard (Federal Specification P-D-680, Type 1).

(d) Check for free fit without binding of pressure sensing housing with oil pump bore, and of bypass valve sleeve with oil pump bore. If required to obtain free fit, dress bore-mating surfaces of pressure sensing housing and bypass valve sleeve with No. 400 wet or dry abrasive. Thoroughly clean parts with solvent, Stoddard (Federal Specification P-D-680, Type I).

(e) Assemble pressure sensing piston on stem. Install new packing on pressure sensing piston. Install pressure sensing housing and spring on stem. If shims were removed at disassembly, install shims on stem. Install two bypass valve pistons on stem.

(f) Using arbor press, press stem through bypass valve pistons to expose washer groove on stem and install C-washer to secure parts.



(Oil Pump, PN 3071432-5, 3071949-1, or 3071949-2)
Oil Pump Pressure Regulator
(Field Maintenance Breakdown)
Figure 202

R

4. A. (3) Check fit of bypass valve pistons (assembled on stem) with mating surfaces of bypass valve sleeve. If required to obtain free fit without binding, dress internal diameter surfaces of bypass valve sleeve which mate with pistons using No. 600 wet or dry abrasive. Do not expose base metal through hard-anodize finish. If pistons bind in bypass sleeve bore when pressure sensing housing is fully assembled, dress mating external diameter of pressure sensing housing with No. 400 wet or dry abrasive. Thoroughly clean bypass valve sleeve with solvent, Stoddard (Federal Specification P-D-680, Type I).

R (4) Install pressure regulator components as follows.

(a) If bottom spiral retainer was removed, fill slot in bore for bottom spiral retainer with grease (Braycote 248).

(b) Install new packing on outside diameter of bypass valve sleeve.

KEY TO FIGURE 202

2. LOCKNUT (IPC FIG. 50)
3. RETAINING WASHER
4. TOP SPIRAL RETAINER
5. KEY WASHER
6. TOP RETAINER PLATE
7. PACKING
8. PACKING
9. ADJUSTING STUD ASSY
10. CALIBRATION SPRING
11. C-WASHER
12. BYPASS VALVE PISTON
13. BYPASS VALVE PISTON
13A. SHIM
14. SPRING
15. PRESSURE SENSING HOUSING
16. PACKING
17. PRESSURE SENSING PISTON
18. STEM
19. PACKING
20. BOTTOM SPIRAL RETAINER
21. BYPASS VALVE SLEEVE
22. PACKING
23. SCREW
24. WASHER
25. SPIRAL RETAINER
26. PLATE
27. PACKING
28. SPRING
29. POPPET
30. SLEEVE

4. A. (4) (c) If oil pump is removed from engine, press bypass valve sleeve in place through bottom bore on oil pump using care not to damage packing, then install bottom spiral retainer. If oil pump is installed on engine, slowly press bypass valve sleeve into place through top bore, using care not to damage packing.

CAUTION: WHEN PERFORMING THE FOLLOWING STEP, BE SURE PACKING RESTS ON LAND IN PUMP HOUSING AND IS AGAINST TOP EDGE OF BYPASS SLEEVE.

(d) Install new packing above bypass valve sleeve.

(e) Insert stem with assembled parts through top end of bore until bottomed in bore. Check that sensing piston assembly strokes easily and smoothly.

(f) Install calibration spring.

(g) Install new packing on adjusting stud assembly.

(h) Hold housing portion of adjusting stud assembly and fully retract (counterclockwise rotation) adjusting stud.

(i) Install new packing on top retainer plate. Fill slot for top spiral retainer with grease (Braycote 248).

(j) Insert adjusting stud assembly through top retainer plate and install key washer.

(k) Install assembled parts in top end of bore.

(l) Install top spiral retainer. Press down on key washer, if required, to expose slot.

(m) Install retaining washer inside top spiral retainer and install locknut on adjusting stud. Do not tighten locknut.

(n) Rotate adjusting stud six turns clockwise to set pressure regulator at approximately mid-range position.

(o) Install sleeve and poppet in upper bore of housing.

(p) Install spring in upper bore.

4. A. (4) (q) Install new packing in upper bore.

(r) Fill slot for spiral retainer in upper bore with grease (Braycoat 248).

(s) Install plate in upper bore. Press down on plate, as required, to expose slot. Install spiral retainer in upper bore.

(t) Install washer and screw in upper bore.

(5) Adjust oil pressure regulator in accordance with 72-00-00, GENERAL-ADJUSTMENT/TEST, paragraph 10.

B. (All Except Oil Pump, Part No. 3071432-5, 3071949-1, or 3071949-2) Repair Oil Pump Leaks by Replacing Packings (See Figure 203)

(1) Loosen and remove locknut, then remove retaining washer.

(2) Rotate adjusting stud counterclockwise until stop is reached.

(3) Remove top spiral retainer.

(4) Pull out assembled key washer, top retainer plate, packings, and adjusting stud assembly. Assembled parts are under slight spring load from calibration spring. If required for removal, thread locknut onto adjusting stud and pry against locknut. Remove packings from top retainer plate and adjusting stud assembly.

(5) Remove bottom spiral retainer, retainer plate and packing.

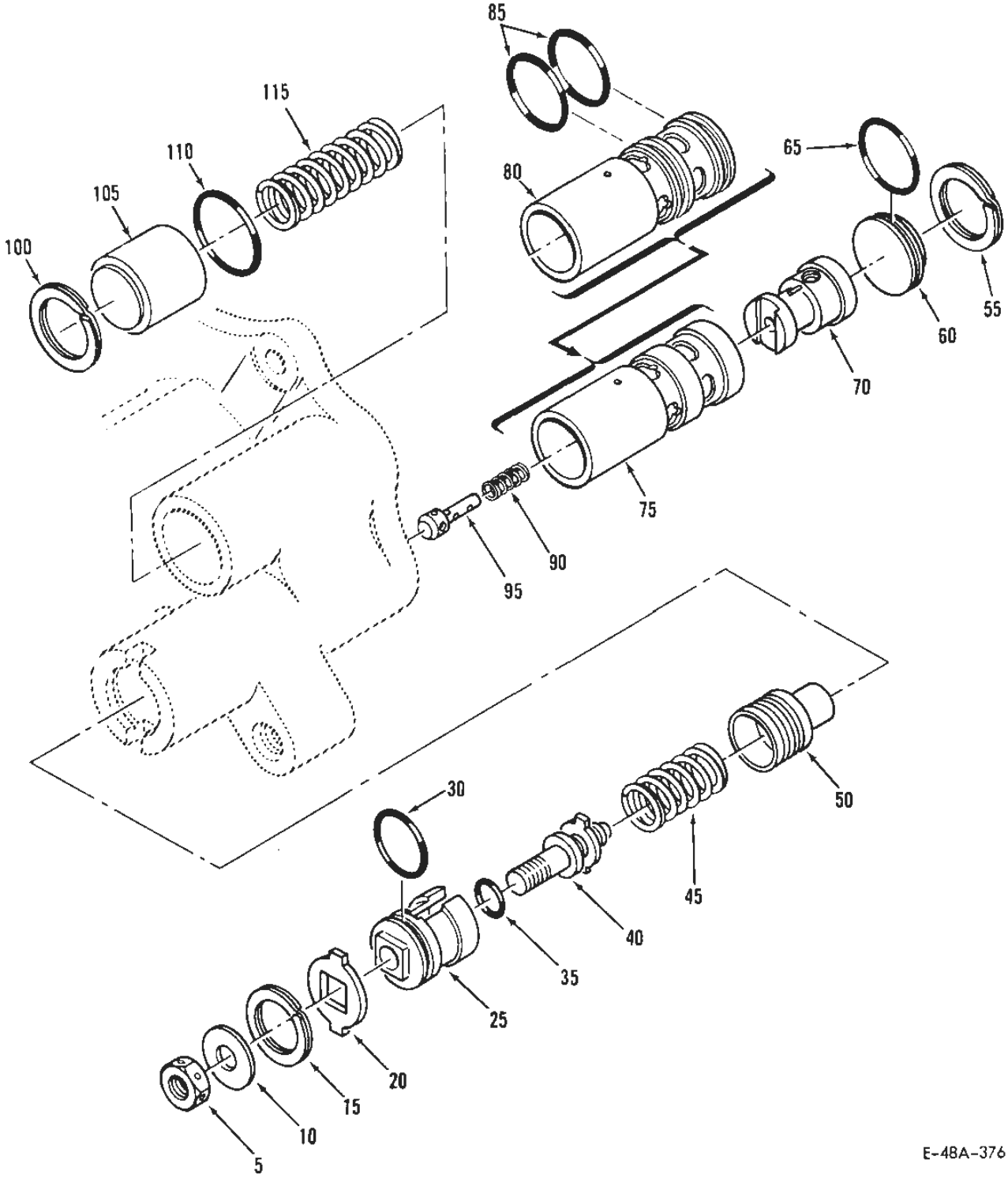
(6) (Oil Pump, Part No. 3071432-7, 3071949-5, or 3071949-6) Push sleeve from pump housing to expose packings installed on sleeve and remove packings. Install new packings on sleeve. Reposition sleeve in pump housing.

(7) Remove spiral retainer, plug, packing and spring from upper bore of pump housing.

(8) Fill slot for spiral retainer in upper bore of pump housing with grease (Braycote 248).

(9) Install spring, new packing, plug and spiral retainer in upper bore.

(10) Fill slot for bottom spiral retainer in pump housing with grease (Braycote 248).



(All Except Oil Pump, PN 3071432-5, 3071949-1 or 3071949-2)
Oil Pump Pressure Regulator
(Field Maintenance Breakdown)
Figure 203

R

4. B. (11) Install new packing in bottom bore, then install retainer plate and bottom spiral retainer.

(12) Install new packing on adjusting stud assembly.

(13) Hold housing portion of adjusting stud assembly and fully retract (counterclockwise rotation) adjusting rod.

(14) Install new packing on top retainer plate. Fill slot for top spiral retainer with grease (Braycote 248).

(15) Insert adjusting stud assembly through top retainer plate, then install key washer.

(16) Install assembled parts in top end of bore.

(17) Install top spiral retainer. Press down on key washer, if required, to expose slot.

(18) Install retaining washer inside top spiral retainer, then install locknut on adjusting stud. Do not tighten locknut.

(19) Rotate adjusting stud six turns clockwise to set pressure regulator at approximately mid-range position.

(20) Adjust oil pressure regulator in accordance with 72-00-00, GENERAL-ADJUSTMENT/TEST, paragraph 10.

KEY TO FIGURE 203

5.	NUT (IPC FIG. 51)	65.	PACKING
10.	WASHER	70.	PISTON VALVE ASSY
15.	TOP SPIRAL RETAINER	75.	SLEEVE (PRE SB79-3012)
20.	KEY WASHER	80.	SLEEVE (POST SB79-3012)
25.	TOP RETAINER PLATE	85.	PACKING
30.	PACKING	90.	SPRING
35.	PACKING	95.	STEM ASSY
40.	ADJUSTING STUD ASSY	100.	SPIRAL RETAINER
45.	SPRING	105.	PLUG
50.	VALVE PISTON	110.	PACKING
55.	BOTTOM SPIRAL RETAINER	115.	SPRING
60.	RETAINER PLATE		

4. C. Repair Corrosion Damaged Areas on Oil Pump Housing

WARNING: METHANOL IS TOXIC AND FLAMMABLE. USE IN WELL-VENTILATED AREA. AVOID BREATHING FUMES OR LONG CONTACT WITH SKIN TO PREVENT DAMAGE TO PHYSICAL HEALTH. KEEP AWAY FROM FLAME TO AVOID FIRE HAZARD.

NOTE: Do not dilute methanol with water or use water (including distilled water) to wash any exposed base metal. Water will cause spreading of corrosion.

(1) Mechanically remove all corrosion by gently wire brushing or sanding. Clean exposed base metal and surrounding area by flushing or swabbing with methanol to remove all traces of dirt, oil, and foreign elements, and to drive out any residual moisture.

(2) Dry all areas to be treated with portable hot air gun for five minutes. Do not allow temperature of surface being repaired to exceed 177C (350F) to prevent scorching any surrounding painted surfaces.

(3) Obtain one gallon touch-up solution (Dow 1). If desired, touch-up solution may be mixed from commercially available chemicals as follows.

(a) Mix 1.5 pounds of sodium dichromate and 1.5 pints of nitric acid with enough demineralized or distilled water to make one gallon of solution.

(b) Stir solution vigorously for 15 minutes, then allow solution to stand for one to two minutes before use.

CAUTION: TOUCH-UP SOLUTION (DOW 1) SHALL NOT BE ALLOWED TO CONTACT ANODIZED SURFACES. A RAPID DETERIORATION OF THE COATING WILL OCCUR.

(4) Apply touch-up solution (Dow 1) to exposed base metal using an acid resistant brush.

(5) Rinse areas with methanol and blot dry. Thoroughly dry areas with portable hot air gun for five minutes, holding temperature of surface being repaired to a maximum of 177C (350F).

(6) Obtain one gallon of touch-up solution (Dow 19). If desired, touch-up solution may be mixed from commercially available chemicals as follows.

4. C. (6) (a) Mix 1.3 ounces of chromic acid flake and one ounce of calcium sulfate with enough demineralized or distilled water to make one gallon of solution.

(b) Stir solution vigorously for 15 minutes before use.

(7) Swab treated area with touch-up solution (Dow 19). Five minutes after application, wipe off excess solution.

(8) Apply protective coating (Clear Coat V92VC10) to treated areas using fine-bristled brush or paint sprayer. Overlap adjacent mating parts by a minimum of 0.20 inch. After application, heat-cure protective coating for approximately 30 minutes at approximately 149C (300F) using portable hot air gun.

(9) When repair area is on surface with a wipe-coat of primer only, reapply primer (P-415-66-611B and Catalyst C1178-66) as follows.

(a) Prepare primer by mixing in equal parts by volume. Allow mixed primer to stand for 30 minutes before application.

(b) Apply one coat of primer, then wipe surface while wet to prevent buildup.

(c) Heat-cure primer for 30 minutes with portable hot air gun at temperature of 135 to 149C (275 to 300F).

(10) When repair area is on surface with color coat, reapply color coat (A423-66 Enamel No. 051 and C1178 Catalyst) as follows.

(a) Prepare primer as specified in step (9)(a).

(b) Apply one coat of primer one mil thick by brushing or spraying.

(c) Heat-cure primer for 30 minutes with portable hot air gun at temperature of 135 to 149C (275 to 300F).

(d) Prepare color coat by mixing A423-66 Enamel No. 051 and C1178 Catalyst in equal parts by volume. Allow mixed color coat to stand for 30 minutes before application.

4. C. (10) (e) Apply one coat of color coat two to three mils thick by either brushing or spraying.

(f) Heat-cure color coat for 30 minutes with portable hot air gun at temperature of 79 to 107C (175 to 225F).

OIL LINES INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed item.	
High temperature compound (Fel-Pro C5-A)	Fel-Pro Inc, Div of Felt Products Mfg Co, 7450 N McCormick Blvd, Skokie, IL 60076

A. Remove Oil Tube Assemblies (See Figure 201)

(1) Remove aft oil scavenge tube assembly.

(2) Loosen integral screws of clamps on aft oil pressure tube assembly. Slide clamps and insulation tubing onto aft oil pressure tube assembly and remove tube assembly, clamps, and insulation sleeving.

(3) If used, remove elbow from boss on exhaust nozzle.

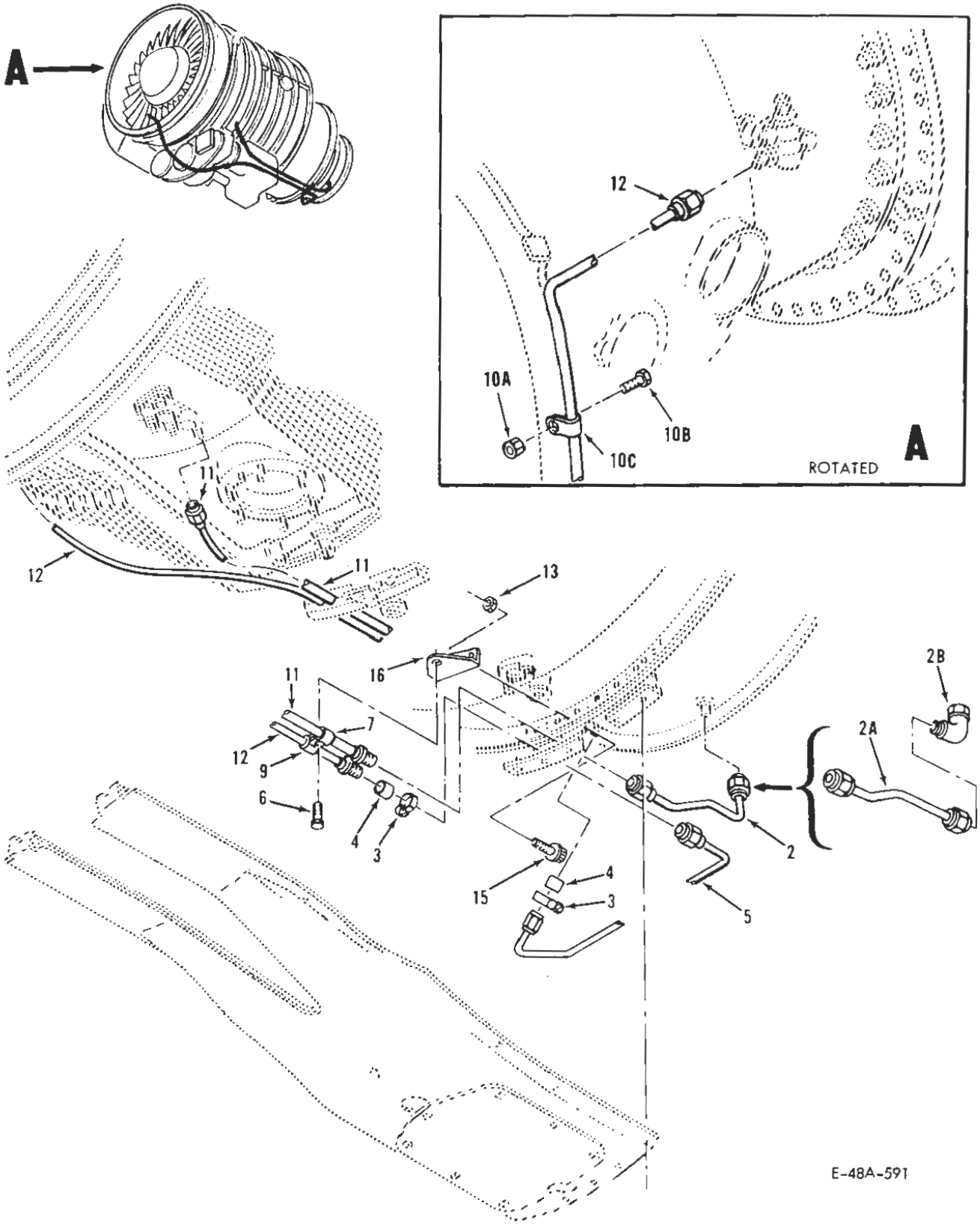
(4) Remove bottom panel in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 203.)

(5) Remove bolt and clamps securing bearing scavenge and lube tube assemblies to bracket at aft plenum case flange. (See figure 201.)

(6) Remove lower service tubes clamp and half sleeves in accordance with 73-10-03, MAINTENANCE PRACTICES.

(7) Remove bearing scavenge tube assembly. (See figure 201.)

(8) Remove right side panel and lower right-side oil (air/oil) cooler in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figures 203 and either 204 or 205.)



Oil Lines Installation
Figure 201

1. A. (9) Remove bolts, nut, and clamps securing bearing lube tube assembly in accordance with 73-10-03, MAINTENANCE PRACTICES.

(10) Remove nuts and bolts securing bottom panel mounting bracket to engine in accordance with 79-20-09, MAINTENANCE PRACTICES (See 79-20-09, figure 203).

(11) Remove nut, bolt, and clamp securing bearing lube tube assembly to forward flange of plenum case and remove bearing lube tube assembly. (See figure 201.)

(12) Remove nuts and bolts securing bracket and remove bracket.

B. Install Tube Assemblies (See Figure 201)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Secure bracket to aft plenum case flange with nuts and bolts.

(2) Tighten bolts (15) to torque of 80 inch-pounds.

KEY TO FIGURE 201

2. AFT OIL SCAVENGE TUBE (CODES A, B) (IPC FIG. 58)
2A. AFT OIL SCAVENGE TUBE ASSY
2B. ELBOW
3. CLAMP
4. INSULATION TUBING
5. AFT OIL PRESSURE TUBE ASSY
6. BOLT
7. CLAMP
9. CLAMP
10A. NUT
10B. BOLT
10C. CLAMP
11. BEARING SCAVENGE OIL TUBE ASSY
12. BEARING LUBE TUBE ASSY
13. NUT
15. BOLT
16. BRACKET

1. B. (3) Install bearing lube tube assembly and secure with clamp, nut, and bolt at forward flange of plenum case. Tighten nut (10A) to torque of 55 to 75 inch-pounds.

(4) Install clamps with bolts and nut on bearing lube tube assembly in accordance with 73-10-03, MAINTENANCE PRACTICES.

(5) Install lower right-side oil (air/oil) cooler and right side panel in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figures 203 and either 204 or 205.)

(6) Install bearing scavenge tube assembly. (See figure 201.)

(7) Install half sleeves and lower service tubes clamp in accordance with 73-10-03, MAINTENANCE PRACTICES.

(8) Secure bearing lube and scavenge oil tube assemblies to bracket at aft plenum case flange with clamps and bolts. (See figure 201.)

(9) Install bottom panel mounting bracket on plenum case flange in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 203.)

(10) Install bottom panel in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 203.)

(11) If used, install elbow at oil scavenge boss on thrust and exhaust nozzle. (See figure 201.)

(12) Install aft oil pressure tube assembly, insulation sleeving, and clamps. Slide insulation sleeving and clamps over tube assembly nuts. Tighten integral screws of clamps (3) to torque of 20 to 25 inch-pounds.

(13) Install aft oil scavenge tube assembly.

2. Inspection/Check

R A. Inspect Oil Tube Assemblies

(1) Inspect tubes for corrosion, cracked flares, or dents which cause a crease or reduce diameter more than ten percent.

(2) Inspect fittings for damaged threads, sleeves, or nuts.

(3) Replace parts which do not meet inspection requirements of steps (1) and (2).

3. Cleaning/Painting

A. Clean Parts

Clean all standard metallic hardware in accordance with 72-00-00, GENERAL-CLEANING/PAINTING, Cleaning Method 1 or 2. Clean plumbing and fittings in accordance with 72-00-00, GENERAL-CLEANING/PAINTING, Cleaning Method 12.

REAR TURBINE BEARING OIL TUBES INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed item.	
High temperature compound (Fel-Pro C5-A)	Fel-Pro Inc, Div of Felt Products Mfg Co, 7450 N McCormick Blvd, Skokie, IL 60076

A. Remove Rear Turbine Bearing Oil Tubes (See Figure 201)

(1) Remove oil tube assemblies connected to bosses on right side and bottom of thrust and exhaust nozzle in accordance with 79-20-04, MAINTENANCE PRACTICES.

(2) Remove N1 transducer access cover plate in accordance with 77-10-03, MAINTENANCE PRACTICES.

(3) Remove bolts securing oil-in and oil-out tubes to transducer support and thrust and exhaust nozzle.

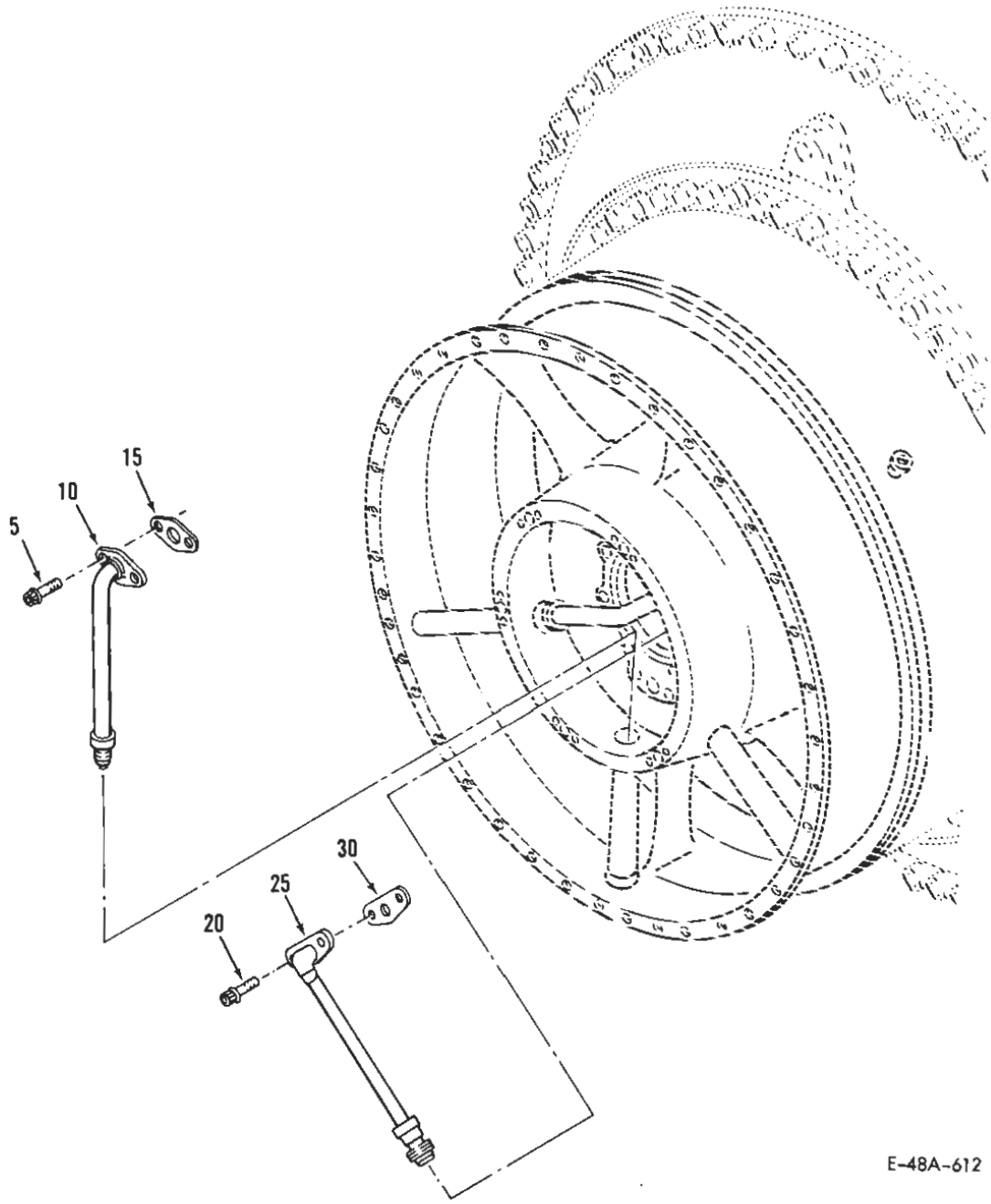
(4) Remove oil-in and oil-out tubes. Remove gaskets from tubes.

B. Install Rear Turbine Bearing Oil Tubes (See Figure 201)

R CAUTION: IF OIL-IN TUBE IS NOT PROPERLY ALIGNED
R OVER MATING ALIGNMENT PIN OF THRUST AND
R EXHAUST NOZZLE, ALIGNMENT PIN AND OIL-IN
R TUBE WILL BE DAMAGED WHEN TUBE IS BOLTED
R IN PLACE AND OIL LEAKAGE WILL RESULT.

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Apply high temperature compound (Fel-Pro C5-A) to
R threads of bolts for securing oil-in and oil-out tubes.
R Install gaskets. Position oil-in and oil-out tubes
R over mounting pads on thrust and exhaust nozzle, ensur-
R ing oil-in tube is properly seated over alignment pin
R in nozzle. (Refer to 72-50-02.) Secure gaskets and
R tubes with bolts. Tighten bolts (5) to torque of 35



5. BOLT (IPC FIG. 93)
10. OIL-OUT TUBE
15. GASKET
20. BOLT
25. OIL-IN TUBE
30. GASKET

R Rear Turbine Bearing Oil Tube Installation
Figure 201

inch-pounds. Tighten bolts (20) to torque of 50 inch-pounds.

1. B. (2) Install N1 transducer access cover plate in accordance with 77-10-03, MAINTENANCE PRACTICES.

(3) Install oil tube assemblies connected at bosses on right side and bottom of thrust and exhaust nozzle in accordance with 79-20-04, MAINTENANCE PRACTICES.

2. Inspection/Check

A. Inspect Rear Turbine Bearing Oil Tubes

(1) Inspect for cracks, chafing, corrosion, internal obstructions, or dents which cause a crease or reduces diameter by more than ten percent.

(2) Inspect oil-out tube for flatness of gasket mating surface by placing straight edge in line with mounting bolt holes. Oil-out tube distortion is not acceptable.

(3) Replace part that does not meet inspection requirements of steps (1) and (2).

3. Cleaning/Painting

A. Clean Parts

(1) Clean all standard metallic hardware in accordance with 72-00-00, GENERAL-CLEANING/PAINTING, Cleaning Method 1 or 2.

(2) Clean oil tubes in accordance with 72-00-00, GENERAL-CLEANING/PAINTING, Cleaning Method 12.

FUEL HEATER OR OIL-TO-COOLER TUBE INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

   A. Remove and Install Oil Tubes (See Figures 201, 202, and 203)

      NOTE: Remove oil tubes only if 2, Inspection/Check reveals damage or if removal is required for access to other parts.

      (1) (Codes A, C) Remove oil tubes as follows. (See figures 201 and 203.)

         (a) Remove bolts and washers securing left side elbow to engine. (See figure 201.)

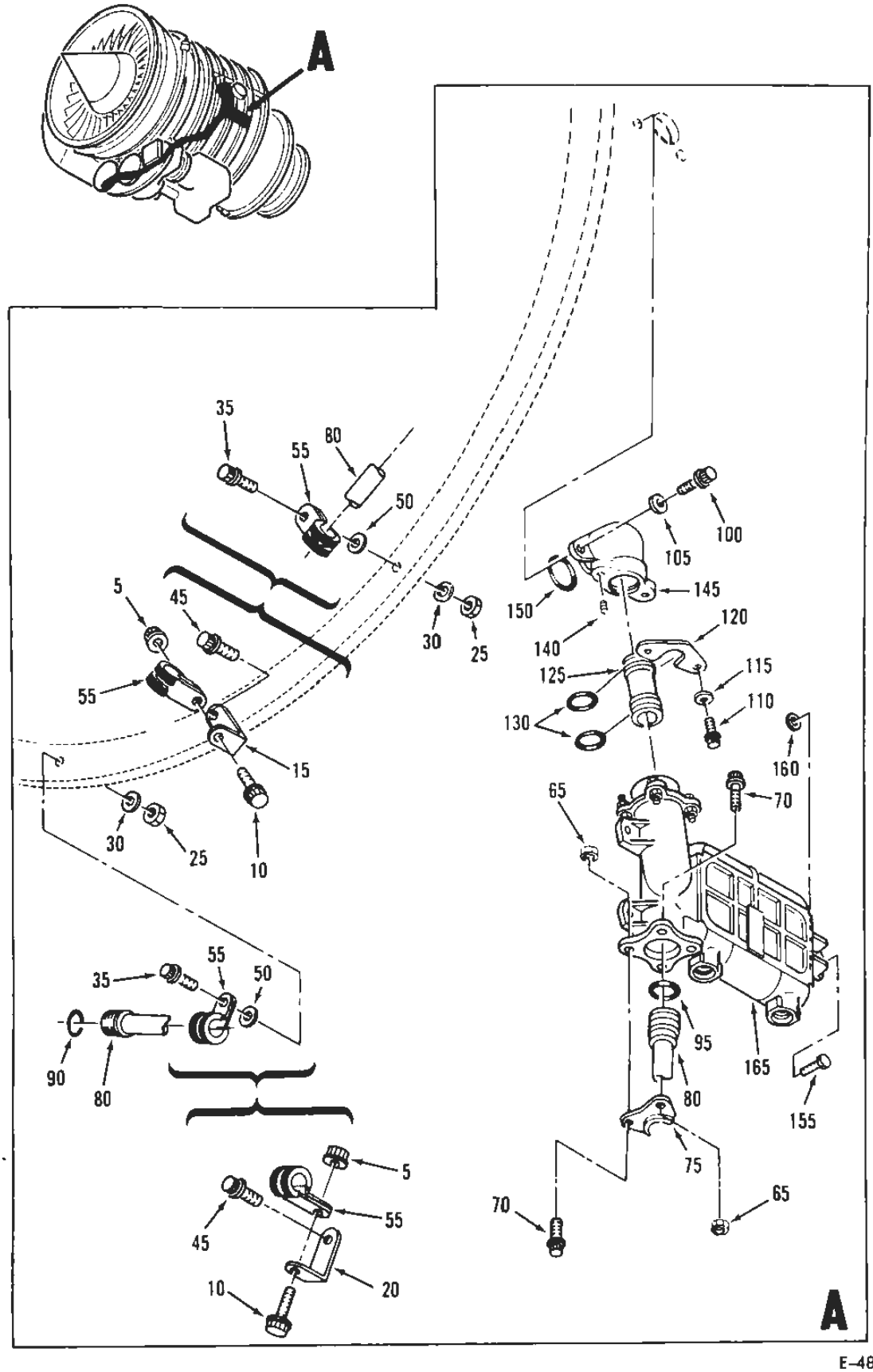
         (b) Remove bolts, washers, and retainer securing oil-out tube to left side elbow. Remove oil-out tube and elbow. Remove packings from oil-out tube and elbow. (See figure 201.)

         (c) Remove nuts, bolts, and retainer securing fluid transfer tube to fuel heater. (See figure 201.)

         (d) Remove nuts and washers securing transfer fitting to gearbox. Remove bolt, washers, and retainer securing other end of transfer fitting to fluid transfer tube and bracket. Remove transfer fitting and bracket. Remove packing from transfer fitting. (See figure 203.)

      (2) (Codes A, C) Install oil tubes as follows. (See figures 201 and 203.)

         NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.



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R (Codes A, C) Fuel Heater Installation
Figure 201

1. A. (2) (a) Install new packings on oil-out tube and left side elbow. Install retainer, bolts, and washers securing oil-out tube to elbow. Tighten bolts
R (110) to torque of 50 inch-pounds. (See figure 201.)

(b) Insert oil-out tube in fuel heater and position elbow on engine. Install bolts and washers securing left side elbow to engine. Tighten bolts
R (100) to torque of 50 inch-pounds. (See figure 201.)

(c) Install bracket. Tighten nuts used to attach bracket to torque of 40 inch-pounds. (See figure 203.)

(d) Install new packings on transfer fitting. Insert transfer fitting into gearbox while simultaneously inserting fluid transfer tube into transfer fitting. Secure transfer fitting to engine, fluid transfer tube and bracket, using retainer, washer, bolts, and nuts. Tighten bolts (30, 40, figure 203) to torque of 50 inch-pounds.

KEY TO FIGURE 201

R 5.	NUT (PART ADDED) (IPC FIG. 54)	95.	PACKING
R 10.	BOLT (PART ADDED)	100.	BOLT
R 15.	BRACKET (PART ADDED)	105.	WASHER
R 20.	BRACKET (PART ADDED)	110.	BOLT
R 25.	NUT	115.	WASHER
R 30.	WASHER	120.	RETAINER
R 35.	BOLT	125.	OIL-OUT TUBE
R 45.	BOLT	130.	PACKING
R 50.	WASHER	*140.	INSERT
R 55.	CLAMP	145.	LEFT SIDE ELBOW
R 60.	NUT	150.	PACKING
R 70.	BOLT	155.	BOLT
R 75.	RETAINER	160.	WASHER
R 80.	FLUID TRANSFER TUBE	165.	FUEL HEATER
R 90.	PACKING		

*NOT REMOVED AT MAINTENANCE LEVEL

1. A. (3) (Code B) Remove oil tube as follows. (See figures 202 and 203.)

(a) Remove bolts and washers securing upper and lower end of left side transfer tube to engine. (See figure 202.)

(b) Remove nuts, bolts, and retainer at lower end of left side transfer tube securing top of fluid transfer tube. Remove left side transfer tube and packing. (See figure 202.)

(c) Remove nuts and washers securing transfer fitting to gearbox. Remove bolts, washers, and retainer securing other end of transfer fitting to fluid transfer tube and bracket. Remove transfer fitting and bracket. Remove packing from transfer fitting. (See figure 203.)

(4) (Code B) Install oil tube as follows. (See figures 202 and 203.)

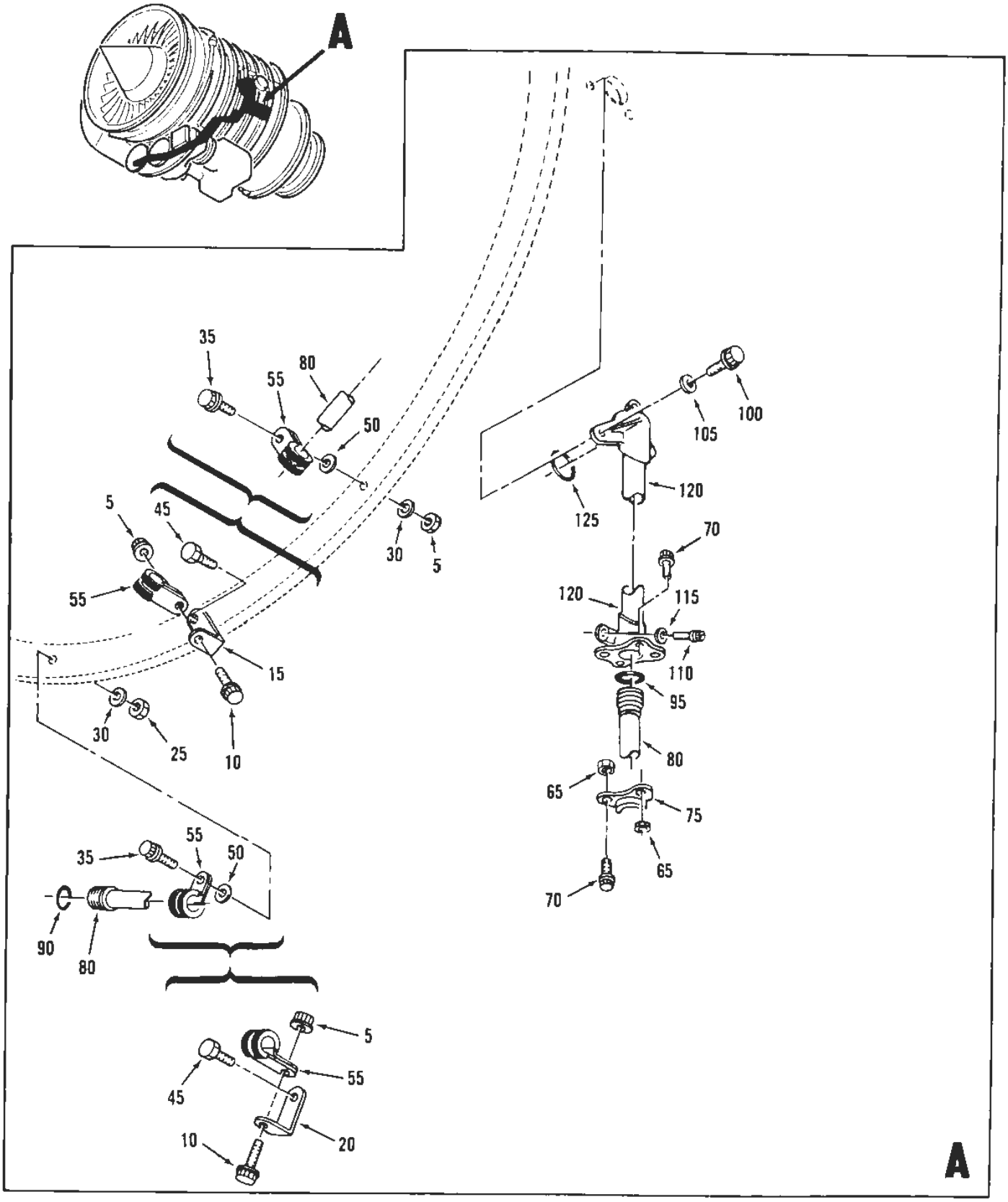
NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(a) Install left side transfer tube on engine with new packing and secure with bolts and washers. Tighten bolts (100) to torque of 50 inch-pounds. Tighten bolt (110) to torque of 70 inch-pounds. (See figure 202.)

(b) Install new packings on fluid transfer tube. Secure fluid transfer tube to left side transfer tube with retainer, bolts, and nuts. Tighten bolts (70) to torque of 50 inch-pounds. (See figure 202.)

(c) Install bracket. Tighten nuts used to attach bracket to torque of 40 inch-pounds. (See figure 203.)

(d) Install new packings on transfer fitting. Insert transfer fitting into gearbox while simultaneously inserting fluid transfer tube into transfer fitting. Secure transfer fitting to engine, fluid transfer tube, and bracket using retainer, washer, bolts, and nuts. Tighten bolts (30, 40, figure 203) to torque of 50 inch-pounds.



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R (Code B) Oil-to-Cooler Tube Installation
Figure 202

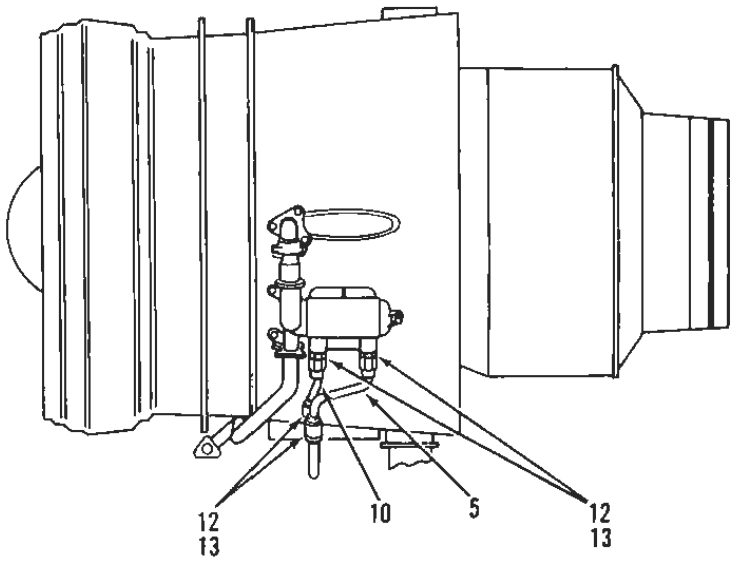
1. A. (4) (b) Install new packings on fluid transfer tube. Secure fluid transfer tube to left side transfer tube with retainer, bolts, and nuts. Tighten bolts (70) to torque of 50 inch-pounds. (See figure 202.)

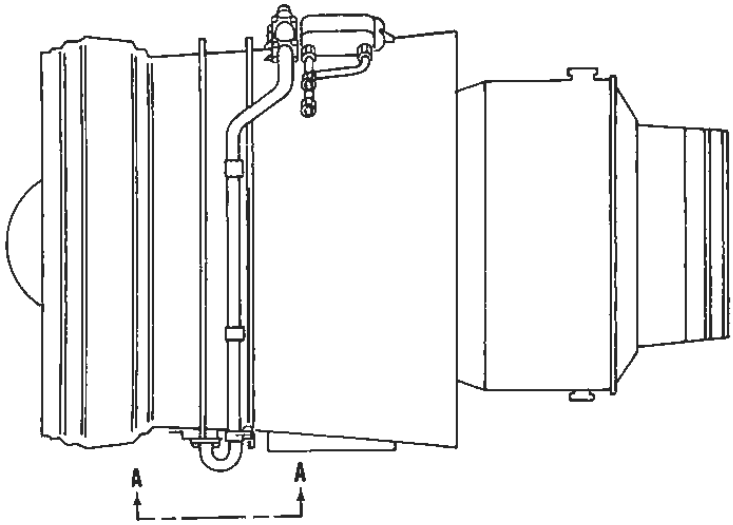
(c) Install bracket. Tighten nuts used to attach bracket to torque of 40 inch-pounds. (See figure 203.)

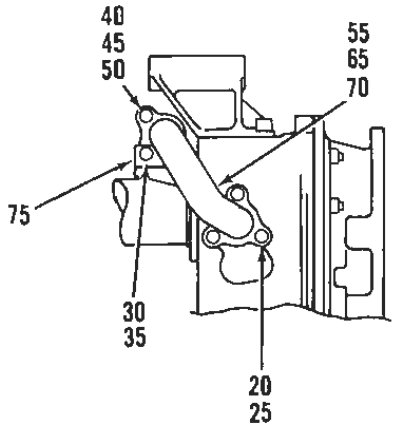
(d) Install new packings on transfer fitting. Insert transfer fitting into gearbox while simultaneously inserting fluid transfer tube into transfer fitting. Secure transfer fitting to engine, fluid transfer tube, and bracket using retainer, washer, bolts, and nuts. Tighten bolts (30, 40, figure 203) to torque of 50 inch-pounds.

KEY TO FIGURE 203

5.	FUEL-OUT TUBE ASSY (CODES A, C) (IPC FIG. 21)	30.	BOLT
10.	FUEL-IN TUBE ASSY (CODES A, C)	35.	WASHER
12.	UNION (CODES A, C)	40.	BOLT
13.	PACKING (CODES A, C)	45.	WASHER
20.	NUT (IPC FIG. 56)	50.	RETAINER
25.	WASHER (PART DELETED) (CODE B)	55.	TRANSFER FITTING
		65.	PACKING
		70.	PACKING
		75.	BRACKET







VIEW A-A

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Fuel Lines and Oil Transfer Fitting Installation
Figure 203

1. R. (Codes A, C) Remove and Install Fuel Heater and Fuel Tubes

(1) Remove fuel heater and fuel tubes as follows. (See figures 201 and 203.)

NOTE: Loosen mounting bolts securing fuel heater if required to remove fuel-in and fuel-out tubes.

(a) Disconnect and remove fuel-in and fuel-out tubes, remove unions, and remove packings. (See figure 203.)

NOTE: Disregard steps (b), (c), and (e) if oil tubes were previously removed.

(b) Remove bolts, nuts, and retainer securing fluid transfer tube to fuel heater. (See figure 201.)

(c) Remove bolts and washers securing left side elbow to engine.

(d) Remove bolts and washers securing fuel heater to engine.

(e) Separate assembled oil-out tube and left side elbow from fuel heater. Separate fluid transfer tube from fuel heater. Remove packings from left side elbow, oil-out tube, and fluid transfer tube.

1. B. (2) Install fuel heater and fuel tubes as follows. (See figures 201 and 203.)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

If a replacement fuel heater is being installed, remove inboard nuts and bolts from oil-out passage. Reinstall bolts on bottom and nuts on top of oil-out passage inboard side. (See figure 201.)

(a) Install new packings on left side elbow, oil-out tube, and fluid transfer tube. (See figure 201.)

(b) Install oil-out tube in left side elbow and secure oil-out tube with retainer, washers and bolts. (See figure 201.)

(c) Insert oil-out tube and fluid transfer tube into fuel heater, then position left side elbow and fuel heater on engine mounting holes. (See figure 201.)

R (d) Secure left side elbow to engine with bolts and washers. Tighten bolts (100) to torque of 50 inch-pounds. (See figure 201.)

NOTE: Washers are installed between the fuel heater and the engine as well as between the fuel heater and the head of bolt. Do not install more than two washers under each pad of fuel heater. (See figure 201.)

(e) Mount fuel heater on engine with bolts, washers, and retainer. Leave bolts loose until installation of fuel-in and fuel-out tubes.

(f) Install new packings on unions and install unions in fuel heater. (See figure 203.)

R (g) Position fuel-in and fuel-out tubes on engine, then tighten bolts (155, figure 201) securing fuel heater to torque of 50 to 70 inch-pounds. Tighten nuts on fuel-in and fuel-out tubes.

R 1. B. (2) (h) Secure fluid transfer tube to fuel heater with bolts, washers, and retainer. Tighten bolts (70) to torque of 50 inch-pounds. (See figure 201.)

C. Remove and Install Fluid Transfer Tube

(1) Remove fluid transfer tube as follows. (See figures 201, 202, and 203.)

NOTE: Removal of fluid transfer tube requires removal of accessory drive gearbox.

(a) Remove oil tubes and associated components in accordance with paragraph 1.A.

(b) (Code A) Disconnect engine wiring harness from components mounted on accessory drive gearbox in accordance with 72-00-02, MAINTENANCE PRACTICES.

(c) (Codes A, C) Remove fuel tubes in accordance with paragraph 1.B.

(d) Remove fuel tubes from oil temperature regulator (fuel/oil cooler) to flow divider and drain valve (or flow divider valve) in accordance with 79-20-07, MAINTENANCE PRACTICES.

(e) Remove oil tubes from oil tank to oil pump and accessory drive gearbox in accordance with 79-10-01, MAINTENANCE PRACTICES.

(f) Remove fuel and P3 sensing tubes installation in accordance with 73-10-02, MAINTENANCE PRACTICES.

(g) Remove fuel system installation in accordance with 73-20-01, MAINTENANCE PRACTICES.

(h) Remove oil pump and chip detector installation in accordance with 79-20-03, MAINTENANCE PRACTICES.

(i) Remove accessory drive gearbox in accordance with 72-60-01, MAINTENANCE PRACTICES.

(j) Remove nuts, bolts, washers, brackets, and clamps securing fluid transfer tube to engine. (See figure 201 or 202.)

(k) Remove bolts, nuts, and retainer securing fluid transfer tube to fuel heater. (See figure 201 or 202.)

1. C. (1) (1) Remove fluid transfer tube from engine. Remove packings from fluid transfer tube. (See figure 201 or 202.)

(2) Install fluid transfer tube as follows. (See figures 201, 202, and 203.)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(a) Install new packings on fluid transfer tube. (See figure 201 or 202.)

R (b) Secure fluid transfer tube with bolts, nuts, and retainers. Tighten bolts (70, figure 201, or 70, figure 202) to torque of 50 inch-pounds.

R (c) Secure fluid transfer tube to engine with bolts, nuts, washers, brackets, and clamps. Tighten bolts (10, 35, 45, figure 201, or 10, 35, 45, figure 202) to torque of 40 inch-pounds.

(d) Install accessory drive gearbox in accordance with 72-60-01, MAINTENANCE PRACTICES.

(e) Install oil pump and chip detector installation in accordance with 79-20-03, MAINTENANCE PRACTICES.

(f) Install fuel system installation in accordance with 73-20-01, MAINTENANCE PRACTICES.

(g) Install fuel and P3 sensing tubes installation in accordance with 73-10-02, MAINTENANCE PRACTICES.

(h) Install oil tubes from oil tank to accessory drive gearbox and oil pump in accordance with 79-10-01, MAINTENANCE PRACTICES.

(i) Install fuel tubes from oil temperature regulator (fuel/oil cooler) to flow divider and drain valve (or flow divider valve) in accordance with 79-20-07, MAINTENANCE PRACTICES.

(j) (Codes A, C) Install fuel tubes in accordance with paragraph 1.B. (See figure 203.)

(k) (Code A) Connect engine wiring harness in accordance with 72-00-02, MAINTENANCE PRACTICES.

2. Inspection/Check

A. Inspect Oil Tubes

(1) Inspect oil tubes for corrosion, cracks, or dents which would restrict fluid flow.

(2) (Codes A, C) Inspect oil-out tube for wear.

(3) (Code B) Inspect left side transfer tube for wear.

(4) Replace items that do not meet inspection requirements of steps (1), (2), and (3).

B. (Codes A, C) Inspect Fuel Heater and Fuel Tubes

(1) Inspect fuel tubes for corrosion, cracked flares, sleeves, or dents which cause a crease or reduce diameter more than ten percent.

(2) Inspect fuel heater for cracks, ruptured welds, or signs of internal leakage. Leakage or damage of oil outlet adapter of fuel heater may be repaired in accordance with 4, Approved Repairs.

(3) Replace parts not meeting inspection requirements of steps (1) and (2), or damaged beyond scope of 4, Approved Repairs.

3. Cleaning/Painting

A. Clean Parts

Clean all standard metallic hardware in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method 1 or 2. Clean plumbing and fittings in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method 12.

4. Approved Repairs

R A. Repair Fuel Heater

R (1) Repair leakage at oil outlet adapter or replace damaged
R oil outlet adapter as follows. (See figure 204.)

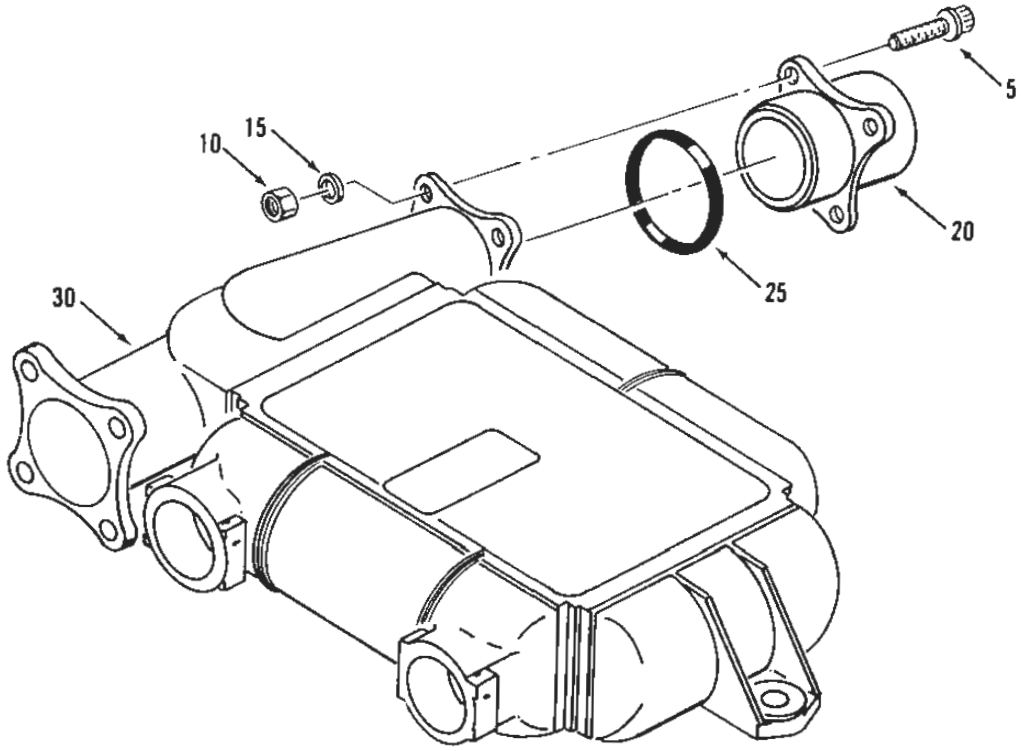
R NOTE: Refer to 70-00-00, STANDARD PRACTICES
R for general torque values. Add fric-
R tional drag (run-down) torque of self-
R locking devices to recommended values.

R (a) Remove nuts, washers, and screws securing oil
R outlet adapter.

R (b) Remove oil outlet adapter. Remove packing from
R oil outlet adapter.

R (c) Install new packing on serviceable oil outlet
R adapter.

R (d) Install oil outlet adapter and secure with nuts,
R washers, and screws.



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5. SCREW (IPC FIG. 55)
10. NUT
15. WASHER
20. OIL OUTLET ADAPTER
25. PACKING
30. FUEL HEATER

R (Codes A, C) Fuel Heater Repair
Figure 204

FUEL/OIL COOLER INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

   A. (Codes A, B) Remove Fuel and Oil Pressure Sensing Lines (See Figure 201)

      (1) (Code A (Production Series 35 and subq), Code B (Production Series 19 and subq) Remove nuts, bolt, clamp, and bracket securing cooler-to-lube jets tube assembly at aft end of oil pump.

      NOTE: Aircraft fuel flow meter may be installed in place of jumper tube assembly.

      (2) Remove fuel-in tube assemblies, jumper tube assembly, cap, tee, fuel-out tube assembly, and associated unions and packings.

      (3) Remove oil pressure sense tube assembly, union, and packing from oil pump.

      (4) Remove cooler-to-lube jets tube assembly from oil temperature regulator (fuel/oil cooler).

   B. (Code C) Remove Fuel and Oil Pressure Sensing Lines (See Figure 202)

      (1) If installed, remove nuts, bolt, clamp, and bracket securing cooler-to-lube jets tube assembly at aft end of oil pump.

      (2) If installed, remove nut, bolt, and clamps securing fuel-in tube assembly to cooler-to-lube jets tube assembly.

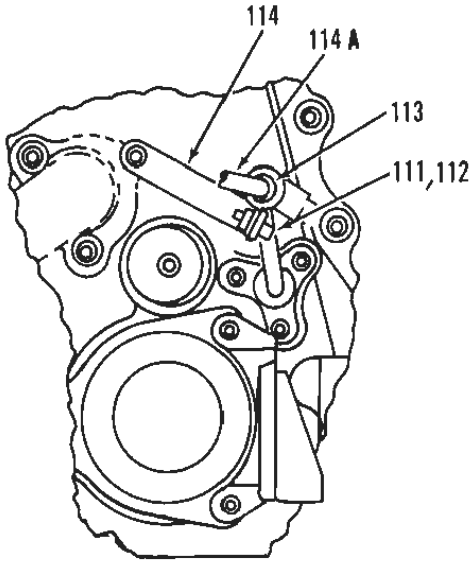
      NOTE: Aircraft fuel flow meter may be installed in place of jumper tube assembly.

      (3) Remove fuel-in tube assemblies, jumper tube assembly, fuel-out tube assembly, and associated unions and packings.

      (4) Remove fitting, nut, washer, and packing at flow divider and drain valve (or flow divider valve).

      (5) If installed, remove elbow, nut, washer, and packing at oil temperature regulator (fuel/oil cooler).

      (6) Remove oil pressure sense tube assembly, union, and packing from oil pump.



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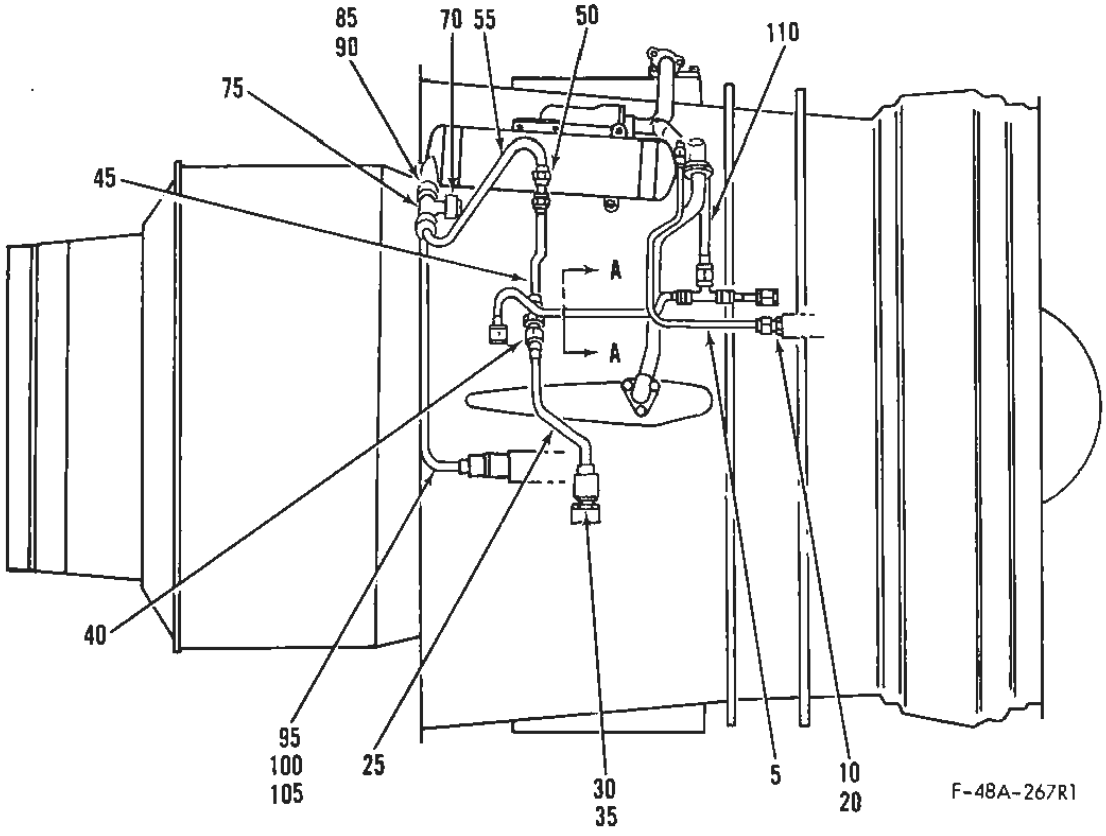
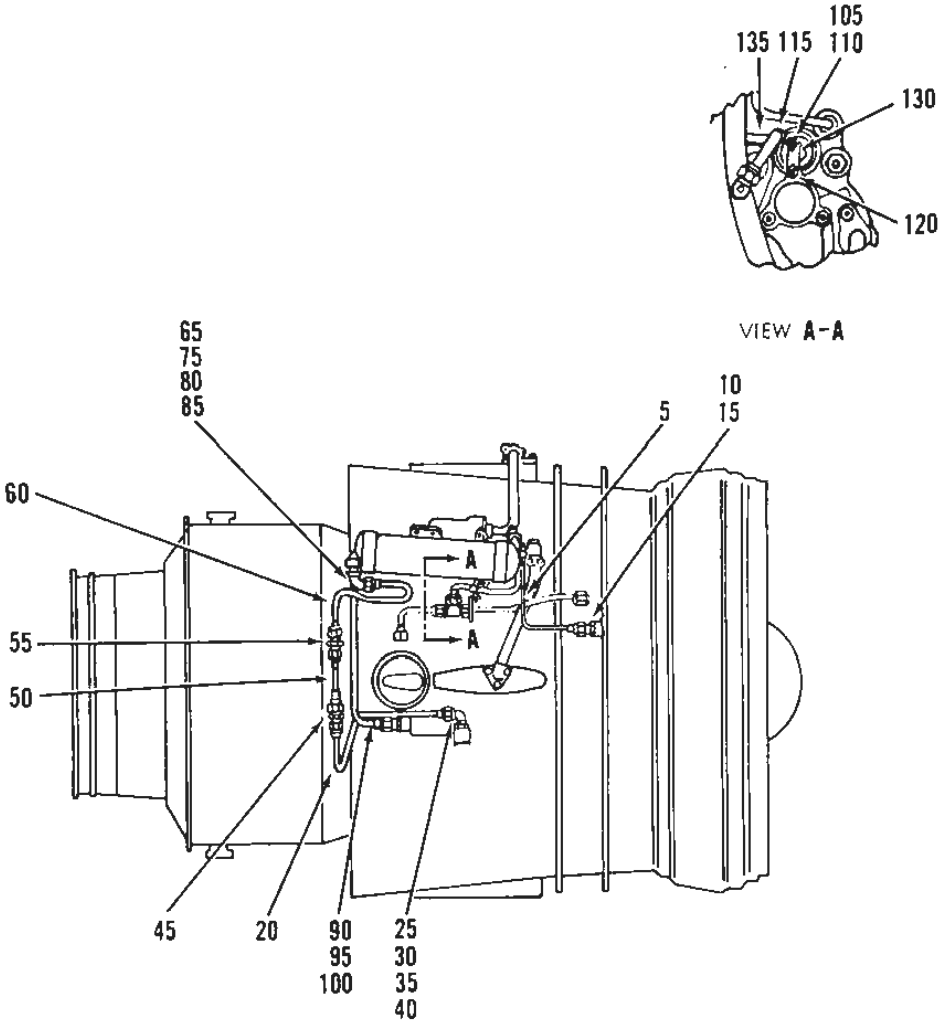


(Codes A, B) Fuel and Oil Pressure Sensing Lines
Figure 201

KEY TO FIGURE 201

5.	OIL PRESSURE SENSE TUBE ASSY (IPC FIG. 22)	100.	UNION
		105.	PACKING
		110.	COOLER-TO-LUBE JETS TUBE ASSY
10.	UNION	111.	NUT (CODE A (SERIES 35 AND SUBQ), CODE B (SERIES 18 AND SUBQ))
20.	PACKING		
25.	FUEL-IN TUBE ASSY	112.	BOLT (CODE A (SERIES 35 AND SUBQ), CODE B (SERIES 18 AND SUBQ))
30.	UNION		
35.	PACKING	113.	CLAMP (CODE A (SERIES 35 AND SUBQ), CODE B (SERIES 18 AND SUBQ))
40.	UNION		
45.	JUMPER TUBE ASSY	114.	BRACKET (CODE A (SERIES 35 AND SUBQ), CODE B (SERIES 18 AND SUBQ))
50.	UNION		
55.	FUEL-IN TUBE ASSY	114A.	COOLER-TO-LUBE JETS TUBE ASSY (CODE A (SERIES 35 AND SUBQ), CODE B (SERIES 18 AND SUBQ))
70.	CAP		
75.	TEE		
85.	UNION		
90.	PACKING		



(Code C) Fuel and Oil Pressure
Sensing Lines Installation
Figure 202

KEY TO FIGURE 202

5.	OIL PRESSURE SENSE TUBE ASSY (IPC FIG. 23)
10.	UNION
15.	PACKING
20.	FUEL-IN TUBE ASSY
25.	FITTING
30.	WASHER
35.	NUT
40.	PACKING
45.	UNION
50.	JUMPER TUBE ASSY
55.	UNION
60.	FUEL-IN TUBE ASSY (PART ADDED)
65.	ELBOW (PART ADDED)
70.	WASHER (PART ADDED)
80.	NUT (PART ADDED)
85.	PACKING
90.	FUEL-OUT TUBE ASSY
95.	UNION
100.	PACKING
105.	NUT (PART ADDED)
110.	BOLT (PART ADDED)
115.	CLAMP (PART ADDED)
120.	NUT (PART ADDED)
130.	BRACKET (PART ADDED)
135.	COOLER-TO-LUBE JETS TUBE ASSY PART ADDED)

1. B. (7) Remove cooler-to-lube jets tube assembly from oil temperature regulator (fuel/oil cooler).

C. Remove Oil Temperature Regulator (Fuel/Oil Cooler) (See Figure 203)

(1) Remove bolts, washers, and retainers securing oil transfer tube, cooler inlet tube, and elbow. Remove elbow, cooler inlet tube, and oil transfer tube, then remove associated packings.

(2) Remove bolts securing adapter to fuel/oil cooler. Remove adapter, then remove packing from adapter.

(3) Remove cap, plug, and packings from adapter.

(4) Remove bolts securing fuel/oil cooler. Remove fuel/oil cooler. If installed, remove washers used between fan duct and fuel/oil cooler.

D. Install Oil Temperature Regulator (Fuel/Oil Cooler) (See Figure 203)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

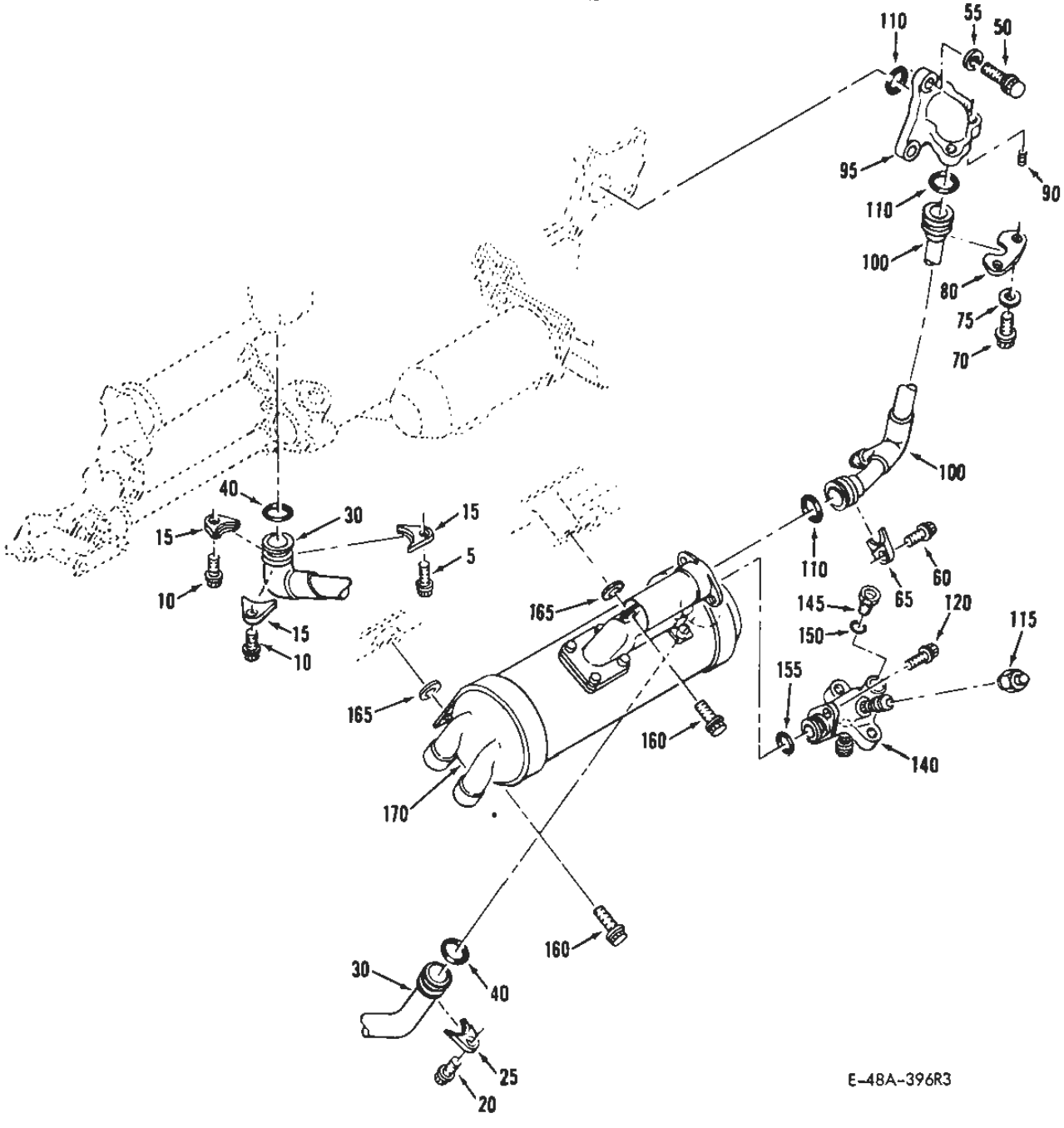
(1) Install fuel/oil cooler on fan duct. If required to obtain clearance between fan duct and fuel/oil cooler, install washers under mounting tabs of fuel/oil cooler. Do not install more than two washers under any one mounting tab. Secure fuel/oil cooler with bolts.

(2) Tighten bolts (160) securing fuel/oil cooler to torque of 50 inch-pounds.

(3) Install cap, plug, and packings on adapter. Tighten plug (145) to torque of 65 to 70 inch-pounds.

(4) Install adapter with packing on fuel/oil cooler and secure with bolts. Tighten bolts (120) to torque of 50 inch-pounds.

(5) Install elbow, cooler inlet tube, and oil transfer tube with packings and secure with bolts, washers, and retainers. Tighten bolts (5, 10, 50, 60, 70) to torque of 50 inch-pounds. Tighten bolt (20) to torque of 25 inch-pounds.



R

5.	BOLT (IPC FIG. 52)	60.	BOLT	120.	BOLT
10.	BOLT	65.	RETAINER	140.	ADAPTER
15.	RETAINER	70.	BOLT	145.	PLUG
20.	BOLT	75.	WASHER	150.	PACKING
25.	RETAINER	80.	RETAINER	155.	PACKING
30.	OIL TRANSFER TUBE	* 90.	INSERT	160.	BOLT
40.	PACKING	95.	ELBOW	165.	WASHER
50.	BOLT	100.	COOLER INLET TUBE	170.	OIL TEMPERATURE REGULATOR (FUEL/ OIL COOLER)
55.	WASHER	110.	PACKING		
		115.	CAP		

*NOT REMOVED AT MAINTENANCE LEVEL

Oil Temperature Regulator (Fuel/Oil Cooler) Installation
Figure 203

1. E. (Codes A, B) Install Fuel and Oil Pressure Sensing Lines (See Figure 201)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Install cooler-to-lube jets tube assembly at oil temperature regulator (fuel/oil cooler).

(2) Install union, packing, and oil pressure sense tube assembly at oil pump.

NOTE: Aircraft fuel flow meter may be used instead of jumper tube assembly.

(3) Install fuel-in tube assemblies, jumper tube assembly, cap, tee, fuel-out tube assembly, and associated unions and packings.

(4) (Code A (Production Engine Series 35 and Subq), Code B (Production Engine Series 18 and Subq)) Install nuts, bolt, clamp, and bracket to secure cooler-to-lube jets tube assembly at aft end of oil pump. Tighten nut at oil pump stud to torque of 20 inch-pounds. Tighten bolt (112) to torque of 20 to 25 inch-pounds.

1. F. (Code C) Install Fuel and Oil Pressure Sensing Lines (See Figure 202)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Install cooler-to-lube jets tube assembly at oil temperature regulator (fuel/oil cooler).

(2) Install union, packing, and oil pressure sense tube assembly at oil pump.

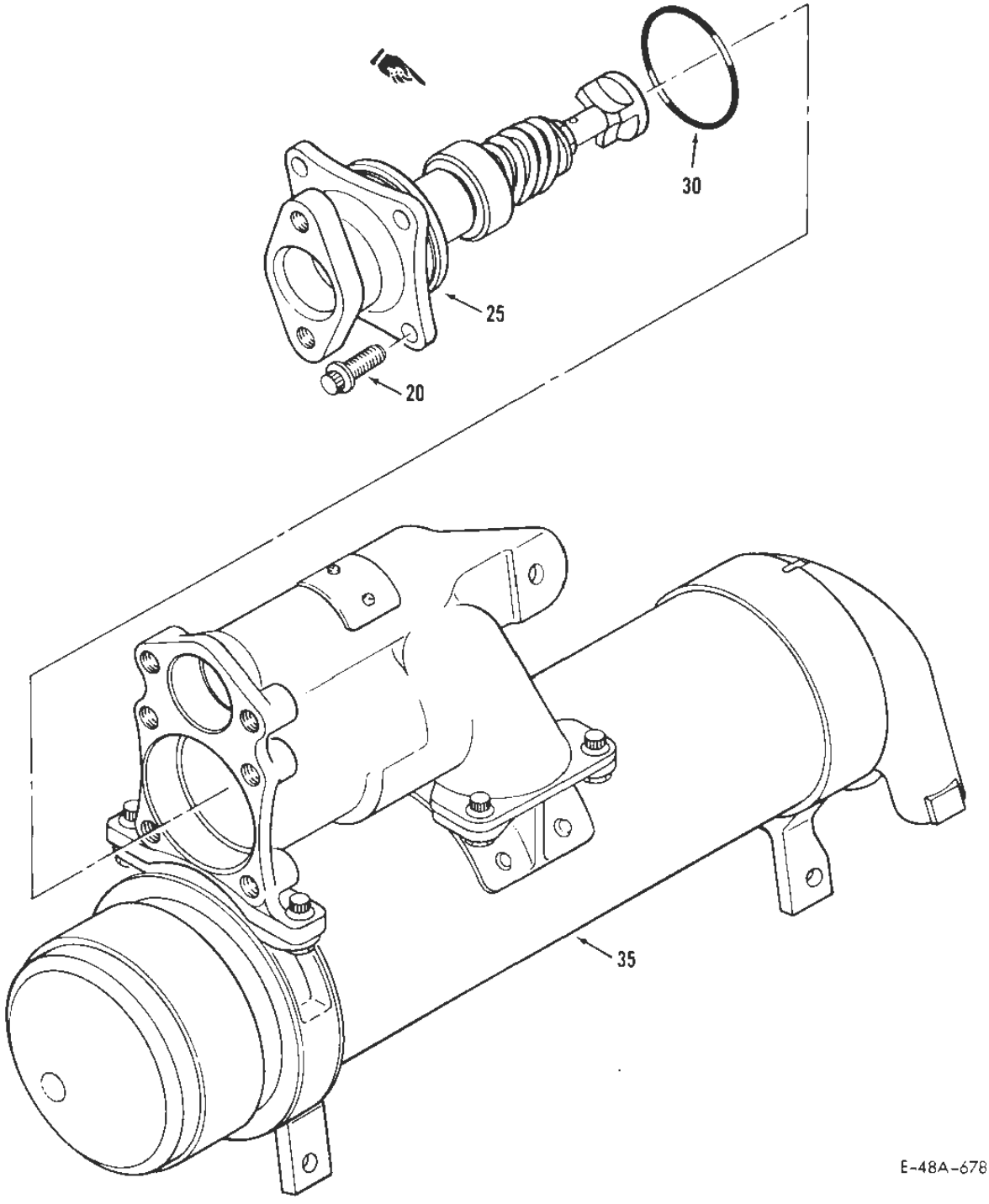
(3) If removed at disassembly, install elbow, nut, washer, and packing at oil temperature regulator (fuel/oil cooler).

(4) Install fitting, nut, washer, and packing at flow divider and drain valve (or flow divider valve).

NOTE: Aircraft fuel flow meter may be used instead of jumper tube assembly.

(5) Install fuel-in tube assemblies, jumper tube assembly, fuel-out tube assembly, and associated unions and packings.

(6) If removed at disassembly, install nuts, bolt, clamp, and bracket to secure cooler-to-lube jets tube assembly at aft end of oil pump. Tighten bolt (110) to torque of 40 inch-pounds.



R 20. BOLT (IPC FIG. 53)
R 25. THERMOSTAT
30. PACKING
35. REGULATOR

R

Oil Temperature Regulator
(Field Maintenance Breakdown)
Figure 204

2. Inspection/Check

A. Inspect Oil and Fuel Tubes

(1) Inspect tubes for corrosion, cracked flares, sleeves, or dents which cause a crease or reduce diameter more than ten percent.

(2) Inspect tube fittings and connections for damage.

(3) Replace tubes if inspection requirements of steps (1) and (2) are not met.

B. Inspect Oil Temperature Regulator (Fuel/Oil Cooler)

(1) Inspect oil temperature regulator (fuel/oil cooler) for cracks, ruptured welds, or signs of leakage. Leakage or damaged thermostat assembly may be repaired in accordance with 4, Approved Repairs.

(2) Check nuts and bolts securing cooler components for tightness. Secure as required.

(3) Replace fuel/oil cooler if cracks, ruptured welds or signs of leakage are evident.

3. Cleaning/Painting

A. Clean Parts

Clean all standard metallic hardware in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method 1 or 2. Clean plumbing and fittings in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method 12.

4. Approved Repairs

R A. Repair Thermostat Assembly

R (1) Repair leakage or damage of thermostat assembly as
R follows. (See figure 204.)

R NOTE: Refer to 70-00-00, STANDARD PRACTICES
R for general torque values. Add fric-
R tional drag (run-down) torque of self-
R locking devices to recommended values.

R (a) Remove bolts securing thermostat assembly.

R (b) Remove thermostat assembly. Discard packing.

R (c) Replace thermostat assembly if required.

R (d) Install new packing on thermostat assembly, then
R install thermostat assembly in housing and secure
R with bolts. Tighten bolts (20) to torque of 20 to
R 25 inch-pounds and lockwire.

AIR/OIL COOLER INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

Table 201. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed items.	
High temperature compound (Fel-Pro C5-A)	Fel-Pro Inc, Div of Felt Products Mfg Co, 7450 N. McCormick Blvd, Skokie, IL 60076
Lubricating compound (Liqui-Moly, Grade NV, thread compound)	Lockrey Co, Lubricants Div, Cedar Shores, Southampton, NY 11968

A. Remove and Install Right Side Duct and Left Side Fairing

(1) Remove right side duct and left side fairing as follows. (See figure 201.)

(a) Remove left side elbow or transfer tube connected to left side fairing in accordance with 79-20-06, MAINTENANCE PRACTICES.

(b) Remove ignition unit and remove lock plate and grommet securing ignition leads to left side fairing in accordance with 74-00-01, MAINTENANCE PRACTICES.

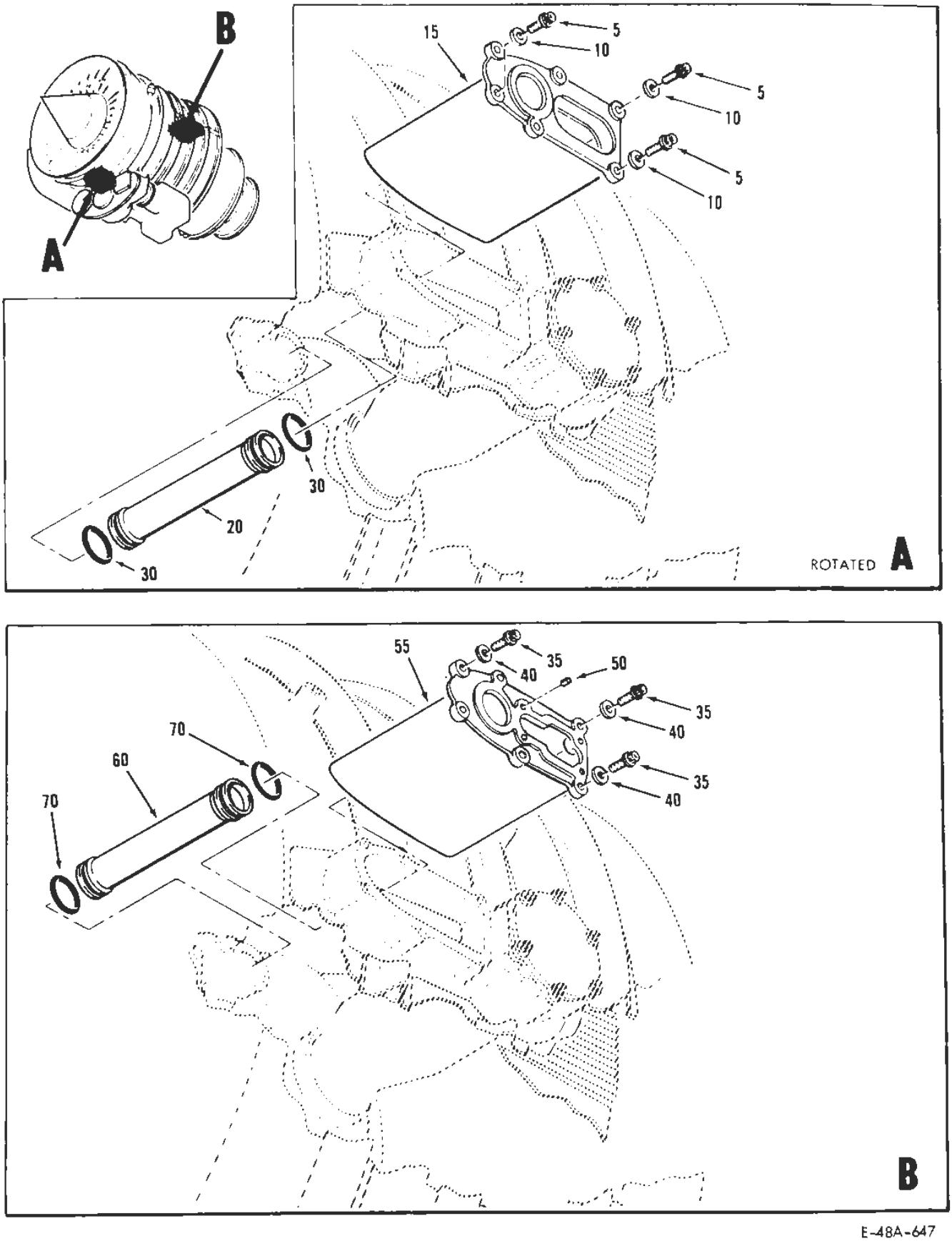
R (c) (Code C) (Codes A, B Pre SB72-3085) Remove pneumatic tube to anti-ice pressure switch connected at right side duct in accordance with 75-10-01, MAINTENANCE PRACTICES.

(d) Remove tube to solenoid controller valve connected at right side duct in accordance with 75-10-01, MAINTENANCE PRACTICES.

(e) Remove remainder of tubes to solenoid controller valve and manifold connected at right side duct in accordance with 76-10-01, MAINTENANCE PRACTICES.

(f) Remove oil-out elbow assemble conected to right side duct in accordance with 79-20-07, MAINTENANCE PRACTICES.

R



Duct and Fairing Installation
Figure 201

1. A. (1) (g) Remove bolts and washers securing right side duct to fan duct assembly. Remove right side duct. Remove oil-out tube, then remove packings from tube.

(h) Remove bolts and washers securing left side fairing to fan duct assembly. Remove left side fairing. Remove oil-in tube and remove packings from tube.

(2) Install right side duct and left side fairing as follows. (See figure 201.)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(a) Apply a light coat of lubricating compound (Liqui-Moly, Grade NV, thread compound) to threads of bolts used to secure left side fairing and right side duct.

(b) Install new packings on oil-in tube, position oil tube on engine, install left side fairing, and secure with bolts and washers. Tighten bolts (35) to torque of 40 inch-pounds.

(c) Install new packings on oil-out tube, position oil tube on engine, install right side duct, and secure with bolts and washers. Tighten bolts (5) to torque of 40 inch-pounds.

(d) Install oil-out elbow assemble on engine in accordance with 79-20-07, MAINTENANCE PRACTICES.

(e) Install tubes to solenoid controller valve and manifold in accordance with 76-10-01, MAINTENANCE PRACTICES.

KEY TO FIGURE 201

5.	BOLT (IPC FIG. 13)	40.	WASHER
10.	WASHER	*50.	INSERT
15.	DUCT, RIGHT SIDE	55.	FAIRING, LEFT SIDE
20.	OIL-OUT TUBE	60.	OIL-IN TUBE
30.	PACKING	70.	PACKING
35.	BOLT		

*NOT REMOVED AT MAINTENANCE LEVEL

1. A. (2) (f) Install tube to solenoid controller valve in accordance with 75-10-01, MAINTENANCE PRACTICES.

R (g) (Code C) (Codes A, B Pre SB72-3085) Install pneumatic tube to anti-ice pressure switch in accordance with 75-10-01, MAINTENANCE PRACTICES.

(h) Install lock plate and grommet to secure ignition leads and install ignition unit in accordance with 74-00-01, MAINTENANCE PRACTICES.

(i) Install left side elbow or transfer tube on left side fairing in accordance with 79-20-06, MAINTENANCE PRACTICES.

B. Remove and Install Oil Transfer Tubes and Bottom Duct Rib

(1) Remove oil transfer tubes and bottom duct rib as follows. (See figure 202.)

(a) (Code A) Disconnect engine wiring harness from fuel control and N2 transducer in accordance with 72-00-02, MAINTENANCE PRACTICES.

(b) Remove oil tubes from accessory drive gearbox to fuel heater or left side transfer tube in accordance with 79-20-06, MAINTENANCE PRACTICES.

(c) Remove oil tubes from oil temperature regulator (fuel/oil cooler) to accessory drive gearbox, transfer gearbox, and bottom duct rib in accordance with 79-20-07, MAINTENANCE PRACTICES.

(d) Remove tubes from oil tank assembly to oil pump and accessory drive gearbox in accordance with 79-10-01, MAINTENANCE PRACTICES.

(e) Remove fuel and P3 sensing lines installation in accordance with 73-10-02, MAINTENANCE PRACTICES.

(f) Remove fuel system installation in accordance with 73-20-01, MAINTENANCE PRACTICES.

(g) Remove oil pump and chip detector installation in accordance with 79-20-03, MAINTENANCE PRACTICES.

(h) Remove accessory and transfer gearbox installation in accordance with 72-60-01, MAINTENANCE PRACTICES.

(i) Remove elbows from bottom duct rib.

1. B. (1) (j) Remove bolts and washers securing bottom duct rib to fan duct.

(k) Remove bolts securing fairing to bottom duct rib and remove fairing.

(l) Remove bottom duct rib. Remove packings from tubes on engine which exit through bottom duct rib.

(m) Remove oil transfer tubes. Remove packings from tubes.

(n) If installed, remove plug and packing from bottom duct rib.

(2) Install oil transfer tubes and bottom duct rib as follows.

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(a) If removed at disassembly, install new packing and plug on bottom duct rib and install lockwire on plug.

(b) Install new packings on oil transfer tubes and install tubes in bottom duct rib.

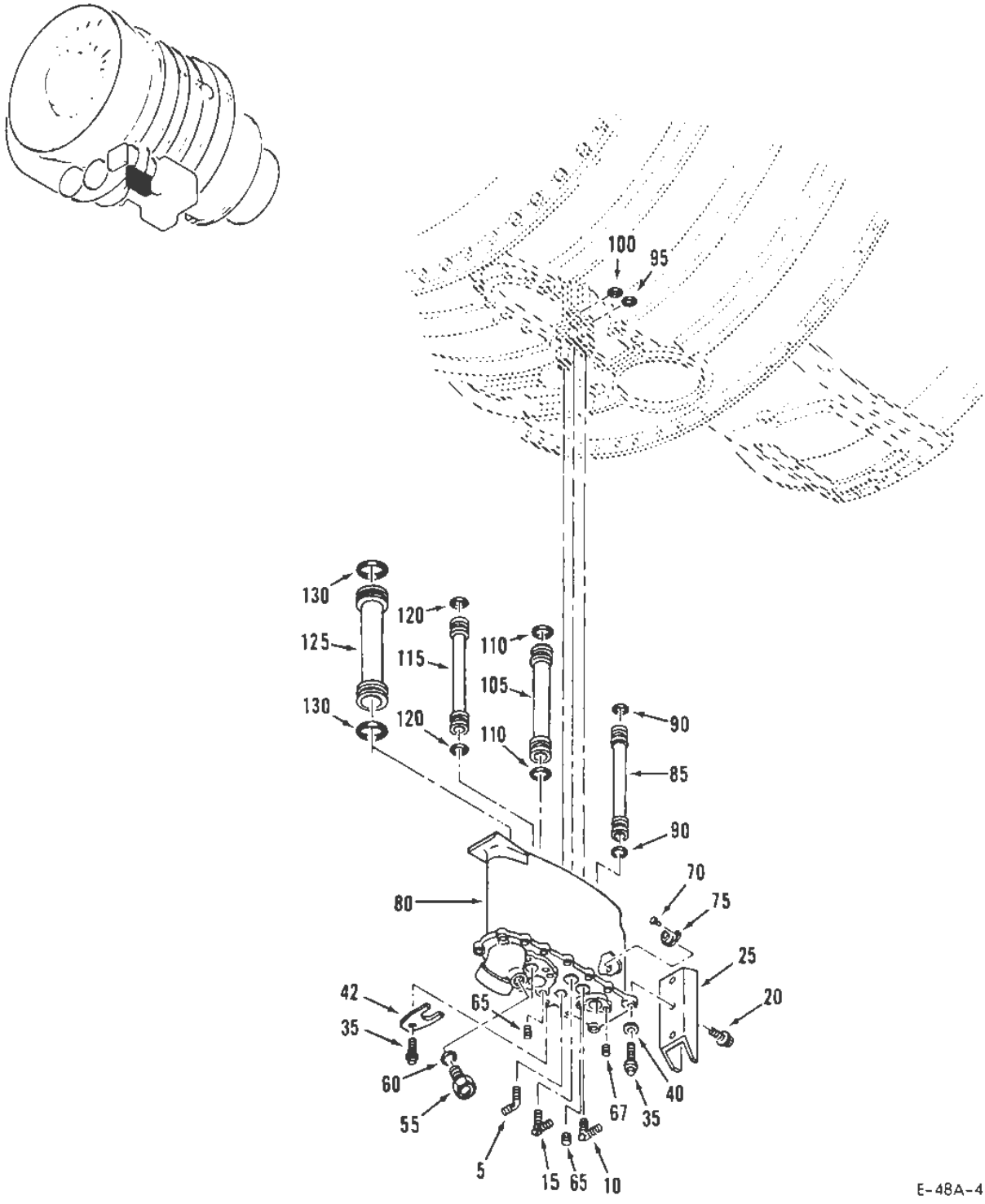
(c) Install new packings on tubes on engine which exit through bottom duct rib and install bottom duct rib in fan duct.

(d) Apply a light coat of lubricating compound (Liqui-Moly, Grade NV, thread compound) to threads of bolts used to secure fairing and bottom duct rib. Position fairing on bottom duct rib and secure with bolts. Tighten bolts (20) to torque of 40 inch-pounds. Secure bottom duct rib to fan duct with bolts and washers. Tighten bolts (35) to torque of 40 inch-pounds.

(e) Install elbows in bottom duct rib.

(f) Install accessory and transfer gearbox installation in accordance with 72-60-01, MAINTENANCE PRACTICES.

(g) Install oil pump and chip detector installation in accordance with 79-20-03, MAINTENANCE PRACTICES.



Oil Transfer Tubes and Bottom Duct Rib Installation
Figure 202

1. B. (2) (h) Install fuel system installation in accordance with 73-20-01, MAINTENANCE PRACTICES.

(i) Install fuel and P3 sensing lines installation in accordance with 73-10-02, MAINTENANCE PRACTICES.

(j) Install tubes from oil tank assembly to oil pump and accessory drive gearbox in accordance with 79-10-01, MAINTENANCE PRACTICES.

(k) Install oil tubes from oil temperature regulator (fuel/oil cooler) to accessory drive gearbox, transfer gearbox, and bottom duct rib in accordance with 79-20-07, MAINTENANCE PRACTICES.

(l) Install oil tubes from accessory drive gearbox to fuel heater or left side transfer tube in accordance with 79-20-06, MAINTENANCE PRACTICES.

(m) (Code A) Connect engine wiring harness assembly to fuel control and N2 transducer in accordance with 72-00-02, MAINTENANCE PRACTICES.

C. Remove and Install Side and Botton Panels

(1) Remove side and bottom panels as follows. (See figure 203.)

(a) Remove screws securing bottom panel to engine and mounting bracket. Remove bottom panel.

KEY TO FIGURE 202

5.	ELBOW (IPC FIG. 14)	* 75.	NUTPLATE
10.	ELBOW	80.	BOTTOM DUCT RIB
15.	ELBOW	85.	OIL XFR TUBE
20.	BOLT	90.	PACKING
25.	FAIRING	95.	PACKING
35.	BOLT	100.	PACKING
40.	WASHER	105.	OIL XFR TUBE
42.	PLATE	110.	PACKING
55.	PLUG	115.	OIL XFR TUBE
60.	PACKING	120.	PACKING
*65.	INSERT	125.	OIL XFR TUBE
*67.	INSERT	130.	PACKING
*70.	RIVET		

*NOT REMOVED AT MAINTENANCE LEVEL

1. C. (1) (b) Remove clamp and bracket (for igniter lead) attached with bottom panel mounting bracket in accordance with 74-00-01, MAINTENANCE PRACTICES.

(c) (Code C) Remove fire detector wire bracket at six o'clock position in accordance with 72-50-03, MAINTENANCE PRACTICES.

(d) Disconnect oil tubes adjacent to bottom panel mounting bracket.

(e) Remove bolts and nuts securing dowel plates for bottom panel to engine. Remove dowel plates.

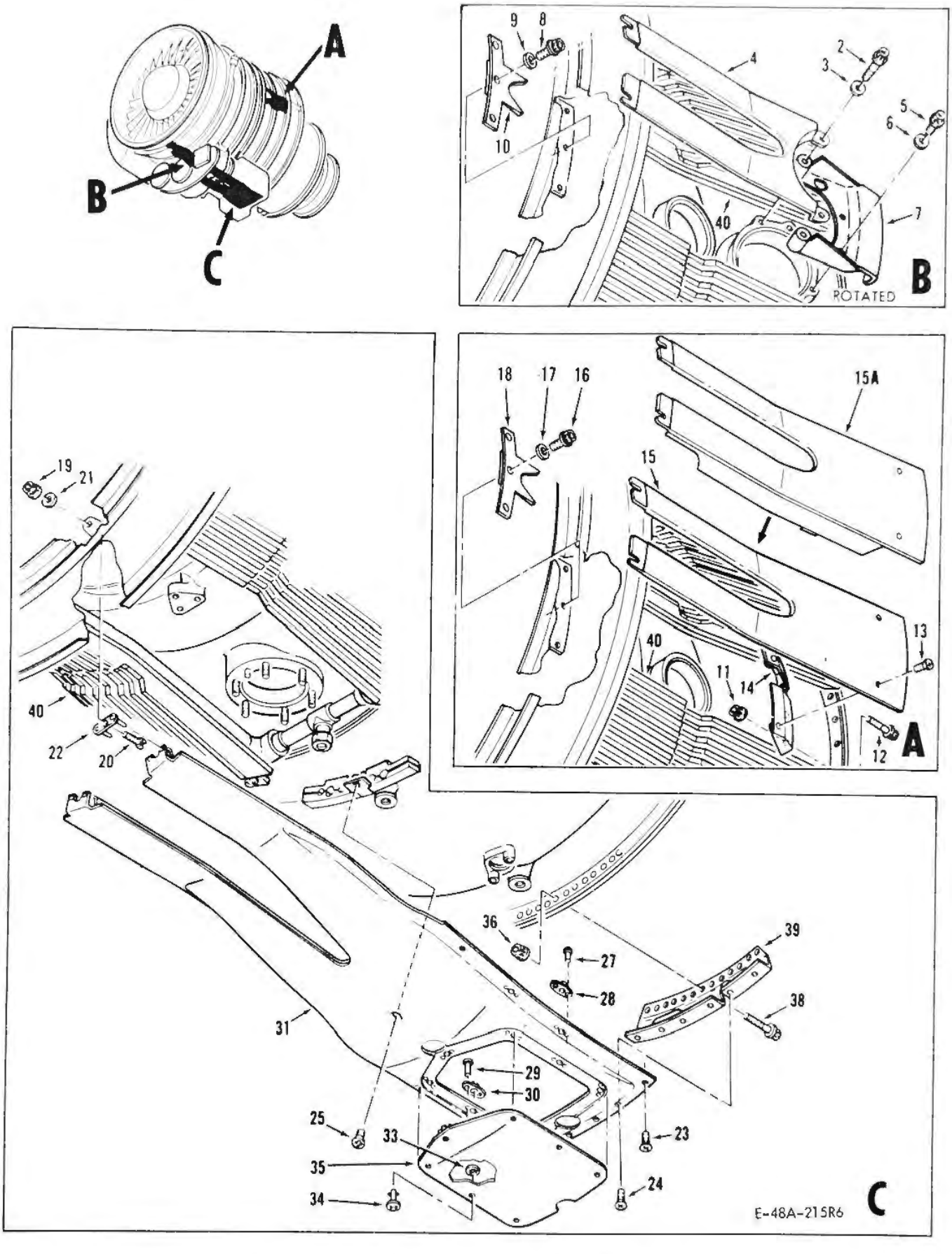
(f) Remove bolts and nuts securing mounting bracket for bottom panel to engine. Remove bracket.

(g) Remove bolts, screws, washers, and nuts securing right bypass duct panel and fairing to engine. Remove right side panel.

(h) Remove bolts, screws, washers, and nuts securing left bypass duct (or segment) fairing, and bracket support. Remove panel or segment, fairing, and bracket support.

KEY TO FIGURE 203

2. BOLT (IPC FIG. 15)
3. WASHER
4. BYPASS DUCT PANEL
5. BOLT
6. WASHER
7. PANEL FAIRING
8. SCREW
9. WASHER
10. FORWARD FAIRING
11. NUT
12. BOLT
13. SCREW
14. BRACKET SUPPORT
15. BYPASS DUCT PANEL
15A. INNER BYPASS DUCT SEGMENT
16. SCREW
17. WASHER
18. LEFT SIDE FAIRING
19. NUT (IPC FIG. 12)
21. WASHER
22. DOWEL PLATE
23. SCREW
24. SCREW
25. SCREW
27. RIVET
28. NUTPLATE
29. RIVET
30. RECEPTACLE
31. BOTTOM PANEL
33. SPLIT WASHER
34. TURNLOCK FASTENER
35. DOOR
36. NUT (IPC FIG. 107)
38. BOLT
39. MOUNTING BRACKET (IPC FIG. 11)
40. AIR/OIL COOLER SECTION (SEE FIGURE 204 OR 205) (IPC FIG. 59 OR 61)



R Side and Bottom Panels Installation
Figure 203

1. C. (2) Install side and bottom panels as follows. (See figure 203.)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

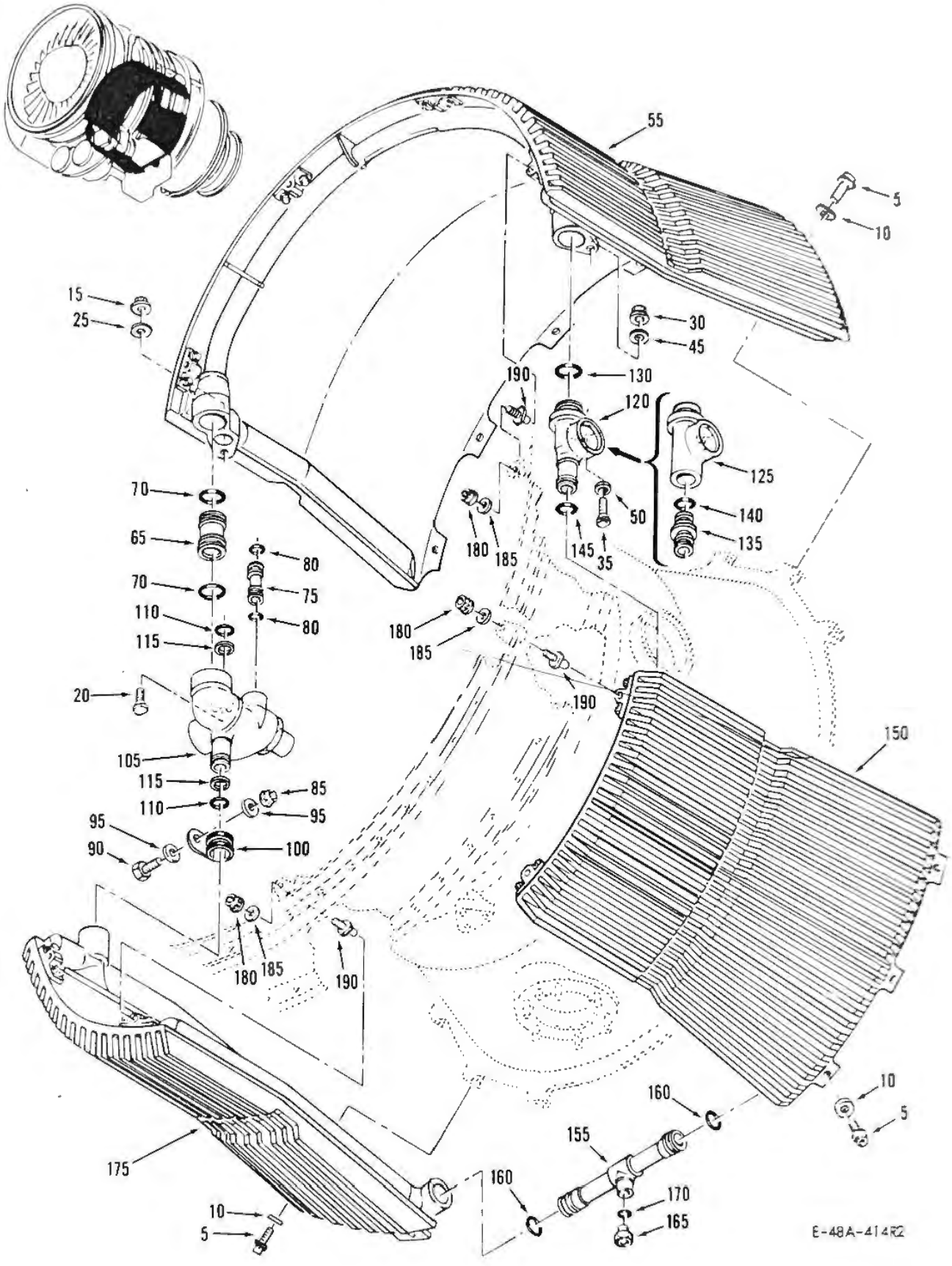
(a) Apply light coat of lubricating compound (Liqui-Moly, Grade NV, thread compound) to threads of bolts and screws for securing fairing, panels, and dowel plates.

(b) Install right side strut forward fairing with center bolt and washer. Do not fully tighten at this time.

(c) Install right bypass duct panel and right side panel fairing. Secure with screws and remainder of bolts and washers. Tighten all bolts (2, 5) and screws (8) to torque of 40 inch-pounds.

KEY TO FIGURE 204

5.	SCREW (IPC FIG. 59)	110.	PACKING
10.	WASHER	115.	PACKING RETAINER
15.	NUT	120.	TEE
20.	BOLT	125.	TEE
25.	WASHER	130.	PACKING
30.	NUT	135.	TRANSFER TUBE
35.	BOLT	140.	PACKING
45.	WASHER	145.	PACKING
50.	WASHER	150.	LOWER LEFT AIR/OIL COOLER
55.	UPPER AIR/OIL COOLER	155.	TRANSFER AND DRAIN TUBE
65.	OIL TRANSFER TUBE	160.	PACKING
70.	PACKING	165.	PLUG
75.	OIL TRANSFER TUBE	170.	PACKING
80.	PACKING	175.	LOWER RIGHT AIR/OIL COOLER
85.	NUT	180.	NUT
90.	BOLT	185.	WASHER
95.	WASHER	190.	DOWEL
100.	CLAMP		
105.	TEMPERATURE CONTROL VALVE		



(Pre SB79-3017) Air/Oil Cooler Installation
Figure 204

1. C. (2) (d) Install left side fairing and secure with center bolt and washer. Do not fully tighten at this time.

(e) Install bracket support and secure with bolts and nuts. Tighten bolts (12) to torque of 55 to 75 inch-pounds.

(f) Install left side bypass duct panel (or segment) and secure panel (or segment) and fairing with screws, bolts, and washers. Tighten screws (16) to torque of 40 inch-pounds. Tighten screws (13) to torque of 30 inch-pounds.

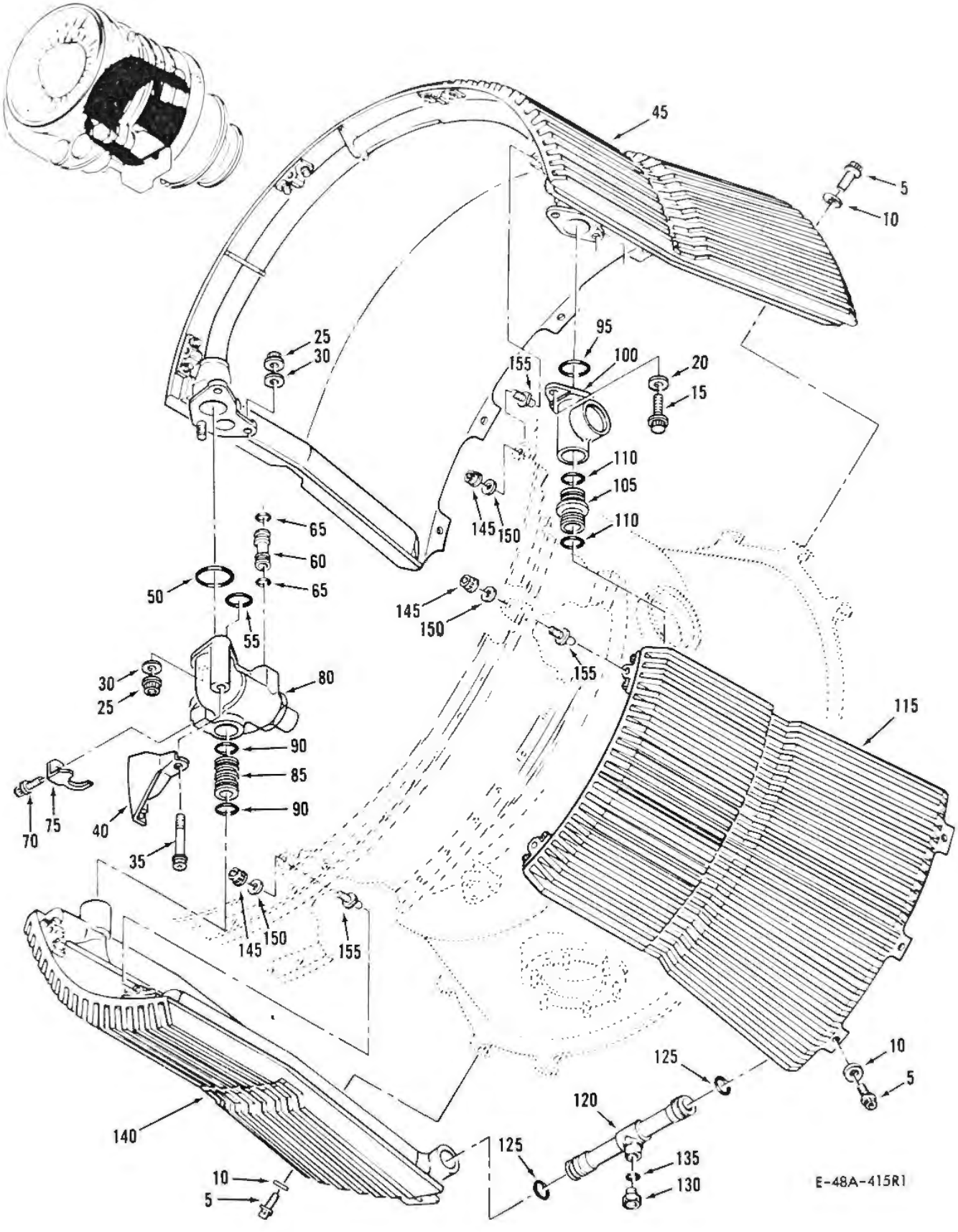
(g) Apply high temperature compound (Fel-Pro C5-A) to threads of bolts for mounting bracket, install bottom panel mounting bracket over oil tubes and secure to engine with bolts and nuts.

(h) Install bracket for clamp on igniter lead adjacent to bottom panel mounting bracket in accordance with 74-00-01, MAINTENANCE PRACTICES.

(i) Install fire detector wire bracket at six o'clock position in accordance with 72-50-03, MAINTENANCE PRACTICES.

KEY TO FIGURE 205

5. SCREW (IPC FIG. 61)
10. WASHER
15. BOLT
20. WASHER
25. NUT
30. WASHER
35. BOLT
40. BRACKET
45. UPPER AIR/OIL COOLER
50. PACKING
55. PACKING
60. OIL TRANSFER TUBE
65. PACKING
70. BOLT
75. RETAINER
80. TEMPERATURE CONTROL VALVE
85. OIL TRANSFER TUBE
90. PACKING
95. PACKING
100. TEE
105. TRANSFER TUBE
110. PACKING
115. LOWER LEFT AIR/OIL COOLER
120. TRANSFER AND DRAIN TUBE
125. PACKING
130. PLUG
135. PACKING
140. LOWER RIGHT AIR/OIL COOLER
145. NUT
150. WASHER
155. DOWEL



(Post SB79-3017) Air/Oil Cooler Installation
Figure 205

1. C. (2) (j) Tighten bolts (38) to torque of 80 inch-pounds.

(k) Install dowel plates on engine and secure with screws, washers, and nuts. Tighten nuts (19) to torque of 30 inch-pounds.

(l) Connect oil tubes adjacent to lower panel mounting bracket.

(m) Install clamp on igniter lead adjacent to mounting bracket. Tighten clamp bolt to torque of 50 inch-pounds.

(n) Install screws securing bottom panel to engine and mounting bracket. Tighten screws (23, 24) to torque of 40 inch-pounds. Tighten screw (25) to torque of 30 inch-pounds.

D. Remove and Install Lower Surface Oil (Air/Oil) Coolers

(1) (Pre SB79-3017) Remove lower surface oil (air/oil) coolers as follows. (See figure 204.)

(a) Remove right-side duct, left side fairing, oil-in and oil-out tubes, and side and bottom panels in accordance with paragraphs 1.A and 1.C.

(b) Remove screws and washers securing lower air/oil coolers.

(c) Remove transfer and drain tube with packings. Remove plug and packings from drain tube.

(d) Maneuver lower right air/oil cooler by twisting outer end up to disengage cooler from forward mounting dowels and temperature control valve. Remove left lower oil cooler in same manner. Remove nuts and washers securing dowels and remove dowels.

(e) Remove nut, washer, and bolt securing temperature control valve to upper surface oil (air/oil) cooler. Remove temperature control valve.

(f) Remove oil transfer tubes from temperature control valve. Remove packings from oil transfer tubes and temperature control. Remove nut, bolt, and washers securing clamp to temperature control valve and remove clamp.

(g) If installed, remove packing retainers from temperature control valve.

1. D. (1) (h) Remove nut, washers, and bolt securing packings from tee.

(i) If installed, remove packing and transfer tube from bore of tee.

(2) (Post SB79-3017) Remove lower surface oil (air/oil) coolers as follows. (See figure 205.)

(a) Remove right-side duct, left-side fairing, oil-in and oil-out tubes, and side and bottom panels in accordance with paragraphs 1.A and 1.C.

(b) Remove screws and washers securing lower air/oil coolers.

(c) Remove transfer and drain tube with packings. Remove plug and packings from drain tube.

(d) Maneuver lower right air/oil cooler by twisting outer end up to disengage cooler from forward mounting dowels and temperature control valve. Remove left lower oil cooler in same manner. Remove nuts and washers securing dowels and remove dowels.

NOTE: To facilitate removal of temperature control valve, loosen two bolts holding manifold (76-10-01, figure 205) and move manifold outward approximately one-eighth inch.

(e) Remove nuts and washers securing temperature control valve to flange of upper air/oil cooler. Remove bolt, bracket, temperature control valve and oil transfer tubes.

(f) Separate bolt and bracket from temperature control valve. Remove bolt securing retainer, then remove retainer and transfer tube. Remove all packings from temperature control valve and transfer tubes.

(g) Remove bolts and washers securing tee to upper air/oil cooler. Remove tee with attached transfer tube, then remove transfer tube from tee. Remove packings from tee and transfer tube.

(3) (Pre SB79-3017) Install lower surface oil (air/oil) cooler as follows. (See figure 204.)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

1. D. (3) (a) If used, install transfer tube new packings in bore of tee.

(b) Install new packings on tee. Position tee in upper air/oil cooler and secure with bolts, washers, and nut. Tighten nut (30) to torque of 40 inch-pounds.

(c) If removed at disassembly, install packing retainers in temperature control valve. Install new packings in temperature control valve.

(d) Install new packings on oil transfer tubes mating with temperature control valve and install oil transfer tubes in temperature control valve. Position temperature control valve in upper air/oil cooler and secure with nut, bolt, and washer. Tighten nut (15) to torque of 40 inch-pounds.

(e) Install dowels and secure with washers and nuts. Tighten nuts (180) to torque of 70 inch-pounds.

R
R
CAUTION: WHEN INSTALLING LOWER RIGHT AIR/OIL COOLER USE CAUTION TO AVOID INTERFERENCE WITH MANIFOLD (76-10-01, FIGURE 205). ALSO AVOID INTERFERENCE OF AIR/OIL COOLER AFT PORT WITH SCREW HEADS.

(f) Position lower right air/oil cooler on temperature control valve, then position on forward mounting dowels. Secure with screws and washers. Tighten screws (5) to torque of 40 inch-pounds. Install lower left air/oil cooler in same manner.

(g) Position clamp on temperature control valve such that bottom edge of clamp is resting on boss of lower right air/oil cooler, and secure with bolts, washers, and nuts. Tighten bolt (90) to torque of 40 inch-pounds.

R NOTE: If air/oil cooler installation is
R to be leak checked, do not install
R plug and packing in transfer and
R drain tube when performing the fol-
R lowing step.

1. D. (3) (h) Install new packing and plug in transfer and drain tube. Tighten plug (165) to torque of 15 inch-pounds. Install new packings on transfer and drain tube, and install tube.

R (i) Install right-side duct, left-side fairing, oil-in
R and oil-out tubes in accordance with paragraphs
R 1.A.

R NOTE: If air/oil cooler installation is
R to be leak checked, do not perform
R the following step.

R (j) Install side and bottom panels in accordance with
R paragraph 1.C.

(4) (Post SB79-3017) Install lower surface oil (air/oil) cooler as follows. (See figure 205.)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(a) Install new packings on transfer tube and install transfer tube in tee.

(b) Install new packing on upper face of tee. Position tee flush against flange of upper air/oil cooler and secure with bolts and washers. Tighten bolts (15) to torque of 70 inch-pounds.

(c) Install dowels and secure with washers and nuts. Tighten nuts (145) to a torque of 70 inch-pounds.

CAUTION: CURVED LIP OF BRACKET MUST FACE FORWARD.

(d) Prior to positioning temperature control valve on engine, insert attaching bolt through bracket and valve. Install packings on upper oil transfer tube and insert upper oil transfer tube into valve. Install packings for mating with boss on upper air/oil cooler on upper face of valve.

R (e) Loosen two bolts securing base of manifold (76-10-
R 01, figure 205) to permit manifold to move outward approximately one-eighth inch.

R 1. D. (4) (f) Move manifold (76-10-01, figure 205) outward as required and position temperature control valve with assembled parts on engine. Install bolts nuts, and washers used to secure temperature control valve, leaving nuts and bolts loose enough to allow alignment of bracket and valve.

(g) Position bracket flush with interfacing mount ring flange while holding temperature control valve flush against upper air/oil cooler base, and bracket flush against temperature control valve. Ensure bracket does not overlap step in mount ring flange, then temporarily install two screws (used to attach forward fairing (figure 203)) through mount ring flange to secure bracket in aligned position.

(h) Alternately tighten nuts and bolt to evenly interface temperature control valve with upper air/oil cooler. Tighten bolt (35) to final torque of 75 inch-pounds and nuts (25) to final torque of 30 inch-pounds.

(i) Remove two screws temporarily installed in step (g) to secure bracket.

(j) Measure clearance between bracket and mount ring flange. Clearance shall not exceed 0.01 inch. If clearance is exceeded, loosen nuts and bolt attaching temperature control valve and repeat step (g) through (j) to obtain proper alignment.

R (k) Tighten two bolts at base of manifold (76-10-01,
R figure 205) to torque of 25 inch-pounds.

(l) Install packings on oil transfer tube and install transfer tube into lower right air/oil cooler. Push transfer tube to full depth to prevent interference during air/oil cooler installation.

CAUTION: WHEN INSTALLING LOWER RIGHT AIR/OIL COOLER OVER DOWELS USE CAUTION TO AVOID INTERFERENCE
R WITH MANIFOLD (76-10-01, FIGURE
R 205). ALSO AVOID INTERFERENCE OF AIR/OIL COOLER AFT PORT WITH SCREW HEADS.

(m) Position lower right air/oil cooler on forward mounting dowels and secure with screws and washers. Tighten screws (5) to torque of 40 inch-pounds.

1. D. (4) (n) Move oil transfer tube installed in step (f) into temperature control valve. Screw driver may be used for oil transfer tube installation; however, use caution not to damage oil transfer tube. Secure transfer tube with retainer and bolt. Tighten bolt (70) to torque of 35 inch-pounds.

R NOTE: If air/oil cooler installation is
R to be leak checked, do not install
R plug and packing in transfer and
R drain tube when performing the fol-
R lowing step.

(o) Install packings on transfer tube for tee. Install packing and plug into transfer and drain tube. Tighten plug (130) to torque value of 15 inch-pounds and lockwire. Install packings on transfer and drain tube and install transfer and drain tube in air/oil cooler. Install transfer tube for tee in lower right air/oil cooler. Install packing into tee and install tee onto transfer tube. Push transfer tube down into lower right air/oil cooler as far as possible.

(p) Position lower right air/oil cooler on forward mounting dowels and transfer and drain tube simultaneously while positioning transfer tube into tee. Secure lower right air/oil cooler with washers and screws, then tighten screws (5) to torque of 40 inch-pounds.

R (q) Install right-side duct, left-side fairing, oil-in
R and oil-out tubes in accordance with paragraph
R 1.A.

R NOTE: If air/oil cooler installation is
R to be leak checked, do not perform
R the following step.

R (r) Install side and bottom panels in accordance with
R paragraph 1.C.

E. Remove and Install Upper Surface Air/Oil Cooler

(1) (Pre SB79-3017) Remove upper surface air/oil cooler as follows. (See figure 204.)

(a) (Code A) Remove engine wiring harness in accordance with 72-00-02, MAINTENANCE PRACTICES.

(b) (Pre SB72-3040) Remove fuel heater or oil to cooler tube installation in accordance with 79-20-06, MAINTENANCE PRACTICES.

1. E. (1) (c) (Pre SB72-3040) Remove fuel/oil cooler installation in accordance with 79-20-07, MAINTENANCE PRACTICES.

(d) (Pre SB72-3040) Remove tubes from oil tank to oil pump and accessory drive gearbox in accordance with 79-10-01, MAINTENANCE PRACTICES.

(e) Remove fuel and P3 sensing lines installation in accordance with 73-10-02, MAINTENANCE PRACTICES.

(f) (Pre SB72-3040) Remove oil pump and chip detector installation in accordance with 79-20-03, MAINTENANCE PRACTICES.

(g) (Pre SB72-3040) Remove fuel system installation in accordance with 73-20-01, MAINTENANCE PRACTICES.

(h) (Pre SB72-3040) Remove accessory and transfer gearbox installation in accordance with 72-60-01, MAINTENANCE PRACTICES.

(i) Remove ignition unit and remove lockplate and grommet securing igniter leads in accordance with 74-00-01, MAINTENANCE PRACTICES.

R R (j) (Code C) (Codes A, B Pre SB72-3085) Remove pneumatic tube to anti-ice pressure switch, pressure switch, and tube to solenoid controller valve in accordance with 75-10-01, MAINTENANCE PRACTICES.

(k) Remove solenoid controller valve and attached tubes in accordance with 76-10-01, MAINTENANCE PRACTICES.

R R R (l) Remove right-side duct, left-side fairing, oil-in and oil-out tubes in accordance with paragraph 1.A.

R R (m) Remove side panels in accordance with paragraph 1.C.

(n) (Pre SB72-3040) Remove oil transfer tubes and bottom duct rib in accordance with paragraph 1.B.

(o) (Pre SB72-3040) Remove screws, bolts, washers, and nuts securing fan duct assembly to engine support housing in accordance with 72-70-05, MAINTENANCE PRACTICES.

1. E. (1) (p) (Post SB72-3040) Remove upper half of fan duct set in accordance with 72-70--05, MAINTENANCE PRACTICES.

(q) (Pre SB72-3040) Remove bleed air duct in accordance with 75-10-05, MAINTENANCE PRACTICES, then remove fan duct assembly.

(r) Remove hardware securing temperature control valve and tee, then press temperature control valve and tee into bosses on lower air/oil coolers to clear upper air/oil cooler.

(s) Remove screws and washers securing upper air/oil cooler and remove upper air/oil cooler. Remove nuts and washers securing dowels and remove dowels.

(t) Remove temperature control valve and tee from lower air/oil coolers, then remove transfer tubes from temperature control. Remove and discard all packings on temperature control valve, tee and transfer tubes. If installed, remove packing retainers from temperature control valve and transfer tube from tee, then remove and discard packings on tee.

(2) (Post SB79-3017) Remove upper surface air/oil cooler as follows. (See figure 205.)

(a) (Code A) Remove engine wiring harness in accordance with 72-00-02, MAINTENANCE PRACTICES.

(b) (Pre SB72-3040) Remove fuel heater or oil to cooler tube installation in accordance with 79-20-06, MAINTENANCE PRACTICES.

(c) (Pre SB72-3040) Remove fuel/oil cooler installation in accordance with 79-20-07, MAINTENANCE PRACTICES.

(d) (Pre SB72-3040) Remove tubes from oil tank to oil pump and accessory drive gearbox in accordance with 79-10-01, MAINTENANCE PRACTICES.

(e) Remove fuel and P3 sensing lines installation in accordance with 73-10-02, MAINTENANCE PRACTICES.

(f) (Pre SB72-3040) Remove oil pump and chip detector installation in accordance with 79-20-03, MAINTENANCE PRACTICES.

1. E. (2) (g) (Pre SB72-3040) Remove fuel system installation in accordance with 73-20-01, MAINTENANCE PRACTICES.

(h) (Pre SB72-3040) Remove accessory and transfer gearbox installation in accordance with 72-60-01, MAINTENANCE PRACTICES.

(i) Remove ignition unit and remove lockplate and grommet securing igniter leads in accordance with 74-00-01, MAINTENANCE PRACTICES.

R R (j) (Code C) (Codes A, B Pre SB72-3085) Remove pneumatic tube to anti-ice pressure switch, pressure switch, and tube to solenoid controller valve in accordance with 75-10-01, MAINTENANCE PRACTICES.

R (k) (Pre SB72-3040) Remove solenoid controller valve and attached tubes in accordance with 76-10-01, MAINTENANCE PRACTICES.

R R R (l) Remove right-side duct, left-side fairing, oil-in and oil-out tubes in accordance with paragraph 1.A.

R R (m) Remove side panels in accordance with paragraph 1.C.

(n) (Pre SB72-3040) Remove oil transfer tubes and bottom duct rib in accordance with paragraph 1.B.

(o) (Pre SB72-3040) Remove screws, bolts, washers, and nuts securing fan duct assembly to engine support housing in accordance with 72-70-05, MAINTENANCE PRACTICES.

(p) (Post SB72-3040) Remove upper half of fan duct set in accordance with 72-70-05, MAINTENANCE PRACTICES.

(q) (Pre SB72-3040) Remove bleed air duct in accordance with 75-10-05, MAINTENANCE PRACTICES, then remove fan duct assembly.

NOTE: To facilitate removal of temperature control valve, loosen two
R R bolts holding manifold (76-10-01, figure 205) and move manifold outward approximately one-eighth inch.

(r) Remove nuts and washers securing temperature control valve to flange of upper air/oil cooler.

Loosen bolt securing bracket, temperature control valve and oil transfer tubes. Press temperature control valve down into lower air/oil cooler to obtain clearance between upper air/oil cooler and temperature control valve flange.

1. E. (2) (s) Remove bolts and washers securing tee to upper air/oil cooler. Press tee down into lower air/oil cooler to obtain clearance between flange of upper air/oil cooler and tee.

(t) Remove screws and washers securing upper air/oil cooler and remove upper air/oil cooler. Remove nuts and washers securing dowels and remove dowels.

(u) Remove temperature control valve and tee with assembled parts from lower air/oil coolers.

(v) Remove bolt and bracket, bolt and retainer, and oil transfer tubes from temperature control valve. Remove transfer tube from tee, then remove and discard all packings on tee, temperature control valve, and transfer tubes.

(3) (Pre SB79-3017) Install upper surface air/oil cooler as follows. (See figure 204.)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(a) Install dowels with nuts and washers. Tighten nuts (180) to torque of 70 inch-pounds.

(b) If used, install transfer tube with new packing in bore of tee.

(c) Install new packings on tee. Install tee in bottom air/oil cooler. Press down on tee until it bottoms out in air/oil cooler.

(d) If removed at disassembly, install packing retainers in temperature control valve. Install new packings in temperature control valve.

(e) Install new packings on oil transfer tubes mating with temperature control valve. Install temperature control valve in lower air/oil cooler. Press down on temperature control valve until it bottoms out in lower air/oil cooler.

1. E. (3) (f) Install upper air/oil cooler on dowels and secure with screws and washers. Tighten screws (5) to torque of 40 inch-pounds.

(g) Position tee in upper air/oil cooler and secure with bolt, washers, and nut. Tighten nut (30) to torque of 40 inch-pounds.

(h) Position temperature control valve in upper air/oil cooler and secure with nut, bolt, and washer. Tighten nut (15) to torque of 40 inch-pounds.

(i) (Pre SB72-3040) Position fan duct assembly on engine and install bleed-air ducts in accordance with 75-10-05, MAINTENANCE PRACTICES.

(j) (Post SB72-3040) Install upper half of fan duct set in accordance with 72-70-05, MAINTENANCE PRACTICES.

(k) (Pre SB72-3040) Secure fan duct assembly to engine support housing in accordance with 72-70-05, MAINTENANCE PRACTICES.

(l) (Pre SB72-3040) Install bottom duct rib and oil transfer tubes in accordance with paragraph 1.B.

R (m) Install right-side duct, left-side fairing, oil-in
R and oil-out tubes in accordance with paragraph
R 1.A.

R (n) Install side panels in accordance with paragraph
R 1.C.

R (o) Install solenoid controller valve and attached
R tubes in accordance with 76-10-01, MAINTENANCE
R PRACTICES.

R (p) (Code C) (Codes A, B Pre SB72-3085) Install pneu-
R matic tube to anti-ice pressure switch, pressure
R switch, and tube to solenoid controller valve in
R accordance with 75-10-01, MAINTENANCE PRACTICES.

R (q) Install lockplate and grommet to secure igniter
R leads and install ignition unit in accordance with
R 74-00-01, MAINTENANCE PRACTICES.

R (r) (Pre SB72-3040) Install accessory and transfer
R gearbox installation in accordance with 72-60-01,
R MAINTENANCE PRACTICES.

R 1. E. (3) (s) (Pre SB72-3040) Install fuel system installation in accordance with 73-20-01.

R (t) (Pre SB72-3040) Install oil pump and chip detector installation in accordance with 79-20-03, MAINTENANCE PRACTICES.

R (u) Install fuel and P3 sensing lines installation in accordance with 73-10-02, MAINTENANCE PRACTICES.

R (v) (Pre SB72-3040) Install tubes from oil tank to oil pump and accessory drive gearbox in accordance with 79-10-01, MAINTENANCE PRACTICES.

R (w) (Pre SB79-3040) Install fuel/oil cooler installation in accordance with 79-20-07, MAINTENANCE PRACTICES.

R (x) (Pre SB72-3040) Install fuel heater or oil to cooler tube installation in accordance with 79-20-06, MAINTENANCE PRACTICES.

R (y) (Code A) Install engine wiring harness in accordance with 72-00-02, MAINTENANCE PRACTICES.

(4) (Post SB79-3017) Install upper surface air/oil cooler as follows. (See figure 205.)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(a) Install dowels with nuts and washers. Tighten nuts (145) to torque of 70 inch-pounds.

(b) Install new packings on transfer tube and install transfer tube in tee.

(c) Install tee in lower air/oil cooler. Press down on tee until it bottoms out in air/oil cooler. Install new packing on top flange of tee.

CAUTION: CURVED LIP OF BRACKET MUST FACE FORWARD.

(d) Prior to positioning temperature control valve on lower air/oil cooler, insert attaching bolt through bracket and valve. Install packings on oil transfer tubes and insert oil transfer tubes into temperature control valve.

1. E. (4) (e) Install temperature control valve, with assembled parts in lower air/oil cooler. Press down on temperature control valve until it bottoms out in air/oil cooler. Install packings on top flange of temperature control valve.

R (f) Deleted.

(g) Install upper air/oil cooler on dowels and secure with screws and washers. Tighten screws (5) to torque of 40 inch-pounds.

(h) Position tee flush against flange of upper air/oil cooler and secure with bolts and washers. Tighten bolts (15) to torque of 70 inch-pounds.

R (i) Move manifold (76-10-01, figure 205) outward as required and position temperature control valve flush against flange of upper air/oil cooler. Install bolt, nuts, and washer used to secure temperature control valve, leaving nuts and bolt loose enough to allow alignment of bracket and valve.

(j) Position bracket flush with interfacing mount ring flange while holding temperature control valve flush against uper air/oil cooler boss and bracket flush against temperature control valve. Ensure bracket does not overlap step in mount ring flange, then temporarily install two screws (used to attach forward fairing (figure 203)) through mount ring flange to secure bracket in aligned position.

(k) Alternately tighten nuts and bolt to evenly interface temperature control valve with upper air/oil cooler. Tighten bolt (35) to final torque of 75 inch-pounds and nuts (25) to final torque of 30 inch-pounds.

(l) Remove two screws temporarily installed in step (j) to secure bracket.

(m) Measure clearance between bracket and mount ring flange. Clearance shall not exceed 0.01 inch. If clearance is exceeded, loosen nuts and bolt attaching temperature control valve and repeat steps (j) through (m) to obtain proper alignment of bracket.

R (n) Tighten two bolts at base of manifold (76-10-01,
R figure 205) to torque of 25 inch-pounds.

R 1. E. (4) (o) Install right-side duct, left side fairing, oil-in
R and oil-out tubes in accordance with paragraph 1.A

R NOTE: If air/oil cooler installation is
R to be leak checked, do not perform
R steps (p) through (z).

R (p) Install side panels in accordance with paragraph
R 1.C.

(q) (Pre SB72-3040) Position fan duct assembly on engine and install bleed-air ducts in accordance with 75-10-05, MAINTENANCE PRACTICES.

(r) (Post SB72-3040) Install upper half of fan duct set in accordance with 72-70-05, MAINTENANCE PRACTICES.

(s) (Pre SB72-3040) Secure fan duct assembly to engine support housing in accordance with 72-70-05, MAINTENANCE PRACTICES.

(t) (Pre SB72-3040) Install bottom duct rib and oil transfer tubes in accordance with paragraph 1.B.

R (u) Install solenoid controller valve and attached tubes in accordance with 76-10-01, MAINTENANCE PRACTICES.

R (v) (Code C) (Codes A, B Pre SB72-3085) Install pneu-
R matic tube to anti-ice pressure switch, pressure switch, and tube to solenoid controller valve in accordance with 75-10-01, MAINTENANCE PRACTICES.

(w) Install lockplate and grommet to secure igniter leads and install igntion unit in accordance with 74-00-01, MAINTENANCE PRACTICES.

(x) (Pre SB72-3040) Install accessory and transfer gearbox installation in accordance with 72-60-01, MAINTENANCE PRACTICES.

(y) (Pre SB72-3040) Install fuel system installation in accordance with 73-20-01.

(z) (Pre SB72-3040) Install oil pump and chip detector installation in accordance with 79-20-03, MAINTENANCE PRACTICES.

1. E. (4) (aa) Install fuel and P3 sensing lines installation in accordance with 73-10-02, MAINTENANCE PRACTICES.

(ab) (Pre SB72-3040) Install tubes from oil tank to oil pump and accessory drive gearbox in accordance with 79-10-01, MAINTENANCE PRACTICES.

(ac) (Pre SB72-3040) Install fuel/oil cooler installation in accordance with 79-20-07, MAINTENANCE PRACTICES.

(ad) (Pre SB72-3040) Install fuel heater or oil to cooler tube installation in accordance with 79-20-06, MAINTENANCE PRACTICES.

(ae) (Code A) Install engine wiring harness in accordance with 72-00-72, MAINTENANCE PRACTICES.

2. Inspection/Check

R Table 202. Special Tools, Fixtures and Equipment

Item No.	Nomenclature	Use	Part No.
NOTE: Equivalent substitutes may be used for listed item.			
1.	*Leak Check Adapter	Used to couple compressed air to air/oil cooler oil-out elbow assembly.	296008-1
	*Symbol (*) indicates item required for air/oil cooler installation leak check only.		

Table 203. Materials and Compounds

Material or Compound	Manufacturer
NOTE: Equivalent substitutes may be used for listed item.	
*Fluid (Sherlock 5 Second Leak Detector, Type I)	Puritan Zep Corp, Aerospace Systems Div, 111 Penn St, El Segundo, CA

*Symbol (*) indicates item required for air/oil cooler installation leak check only.

2. A. Inspect Right-Side Duct, Left-Side Fairing, and Oil Tubes (See Figure 201)

(1) Inspect oil-in and oil-out tubes for corrosion, cracks, or dents which would restrict fluid flow.

(2) Replace components if corrosion, cracks, dents or distortion are evident. Replace oil-in or oil-out tubes if dents which would restrict fluid flow are evident.

B. Inspect Oil Transfer Tubes and Bottom Duct Rib (See Figure 202)

(1) Inspect oil transfer tubes for corrosion, cracks, or dents which reduce diameter more than ten percent or cause a crease.

(2) Inspect bottom duct rib for cracks.

(3) Visually inspect tube guide holes for fretting. Fretting is not acceptable except in guide holes for fuel and P3 lines (where elbows (figure 402, 5, 10, 15) attach).

(4) Replace parts if inspection requirements of steps (1) through (3) are not met.

C. Inspect Side and Bottom Panels (See Figure 203)

(1) Inspect for loose or missing fasteners, corrosion, cracks, dents, or other damage.

(2) Inspect bottom panel for evidence of chafing with tower shaft housing. Refer to 4, Approved Repairs for rework of bottom panel.

2. C. (3) Replace parts if corrosion, cracks, or other damage is evident. Refer to 4, Approved Repairs for repair of fasteners or minor dents.

D. Inspect Air/Oil Coolers (See Figure 204 or 205)

(1) Inspect air/oil coolers for cracks, dents, or distortion.

(2) Replace air/oil coolers if cracks are evident. Bent fins on air/oil coolers are allowable if maximum displacement does not exceed two-thirds the spacing between fins and no cracking has resulted, and if maximum area of bent fins does not exceed three inches in length by 2 inches width.

NOTE: The following step is not required. Perform step only to check for air/oil cooler installation oil leakage prior to engine run.

(3) Check air/oil cooler installation, when installed on engine, for oil leakage as follows.

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(a) Remove oil tank filler plug from oil tank.

(b) Remove cooler inlet tube in accordance with 79-20-07, MAINTENANCE PRACTICES. (See 79-20-07, figure 203.)

(c) Install 296008-1 leak check adapter on elbow (95, figure 203, 79-20-07) and secure with retainer, washers, and bolts used to secure cooler inlet tube to elbow. Tighten bolts (70, figure 203, 79-20-07) to torque of 50 inch-pounds.

(d) If installed, remove side and bottom panels in accordance with pragraph 1.C.

(e) If installed, remove plug and packing from transfer and drain tube in accordance with paragraph 1.D. and connect air pressure gage to allow reading pressure within the range of 25 to 30 psig to transfer and drain tube part.

(f) Connect source of clean, dry, compressed air variable over range of 0 to 150 psig, with air shutoff

valve downstream of air pressure regulator to 296008-1 leak check adapter.

WARNING: A FINE OIL MIST MAY DISCHARGE FROM ENGINE CAVITIES WHEN PERFORMING THE FOLLOWING STEPS. AVOID BREATHING OIL MIST TO PREVENT DAMAGE TO PHYSICAL HEALTH.

CAUTION: ENSURE OIL TANK FILLER PLUG IS REMOVED FROM OIL TANK WHEN PERFORMING THE FOLLOWING STEPS TO PREVENT DAMAGE BY PRESSURIZING TANK.

2. D. (3) (g) Increase air pressure applied to leak check adapter until gage connected to transfer and drain tube indicates 25 +5/-0 psig, then decrease air pressure to 0 psig and increase air pressure again to 25 +5/-0 psig to ensure packings are seating under pressure.

(h) Check for oil mist discharging from air/oil cooler installation plumbing connections or audible indication of leakage.

(i) Apply fluid (Sherlock 5 Second Leak Detector, Type I) to all accessible air/oil cooler installation plumbing connections and check for foaming or bubbles in fluid, indicating leakage.

(j) If leakage is detected in steps (h) or (i), reduce air pressure to 0 psig and repair leak, then repeat steps (g) through (j).

(k) Shut off air supply to 296008-1 leak check adapter and disconnect air supply from adapter.

(l) Remove 296008-1 leak check adapter from elbow.

(m) Remove air pressure gage from transfer and drain tube.

(n) Install new packing on plug and install plug in transfer and drain tube. Tighten plug (165, figure 204, or 130, figure 205) to torque of 15 inch-pounds.

(o) Install cooler inlet tube in accordance with 79-20-07, MAINTENANCE PRACTICES. (See 79-20-07, figure 203.)

(p) Install oil tank filler plug on oil tank.

R 2. D. (3) (q) Install side and bottom panels in accordance with
R paragraph 1.C.

R (r) If removed, install upper half of fan duct set in
R accordance with 72-70-05, MAINTENANCE PRACTICES.

R (s) If removed, install solenoid controller valve and
R attached tubes in accordance with 76-10-01, MAIN-
R TENANCE PRACTICES.

R (t) (Code C) (Codes A, B Pre SB72-3085) If removed,
R install pneumatic tube to anti-ice pressure
R switch, pressure switch, and tube to solenoid con-
R troller valve in accordance with 75-10-01, MAIN-
R TENANCE PRACTICES.

R (u) If removed, install lockplate and grommet to
R secure igniter leads and install ignition unit in
R accordance with 74-00-01, MAINTENANCE PRACTICES.

R (v) If removed, install fuel and P3 sensing lines in-
R stallation in accordance with 73-10-02, MAINTEN-
R ANCE PRACTICES.

R (w) If removed, install engine wiring harness in ac-
R cordance with 72-00-02, MAINTENANCE PRACTICES.

3. Cleaning/Painting

A. Clean Parts

Clean parts as specified in Table 203 in accordance with Cleaning Methods provided in 72-00-00, GENERAL - CLEANING/PAINTING.

Table 203. Cleaning Methods

Figure No.	Item No.	Nomenclature	Cleaning Method 1	2	3	4	5	6	7	8	9	10	11	12
All standard metallic hardware			X	X										
Plumbing and fittings														X
R 201	15	Duct	X	X			X	X						
R	55	Fairing	X	X			X	X						
202	25	Fairing	X	X			X	X						
	80	Rib	X	X			X	X						
203	4	Panel	X	X			X	X						
	7	Fairing	X	X			X	X						
	10	Fairing Assy	X	X			X	X						
	14	Support	X	X							X			

Table 203. Cleaning Methods (Cont)

Figure No.	Item No.	Nomenclature	Cleaning Method 1	2	3	4	5	6	7	8	9	10	11	12
	15	Panel	X	X			X	X						
	15A	Segment	X	X			X	X						
	18	Fairing Assy	X	X			X	X						
	22	Plate	X	X							X			
	31	Panel	X	X										
	35	Door	X	X										
	39	Bracket	X	X										
204	190	Dowel	X	X										
205	155	Dowel	X	X										

4. Approved Repairs

A. Repair Bottom Panels

Replace loose or missing fasteners or bend out repairable dents in accordance with standard shop practices.

R B. Rework Bottom Panel to Prevent Chafing of Tower Shaft
R Housing

R Rework panel to prevent chafing to tower shaft housing by
R trimming panel as required to eliminate chafing.

R

FAN OIL TRANSFER TUBES AND JET INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove Fan Oil Transfer Tubes and Jet (See Figure 201)

R (1) Remove fan spinner and spinner support installation in
R accordance with 72-70-01, MAINTENANCE PRACTICES.

(2) Remove fan rotor assembly in accordance with 72-70-03, MAINTENANCE PRACTICES.

(3) Remove compressor inlet stator in accordance with 72-20-02, MAINTENANCE PRACTICES.

(4) Remove fan support assembly in accordance with 72-70-06, MAINTENANCE PRACTICES.

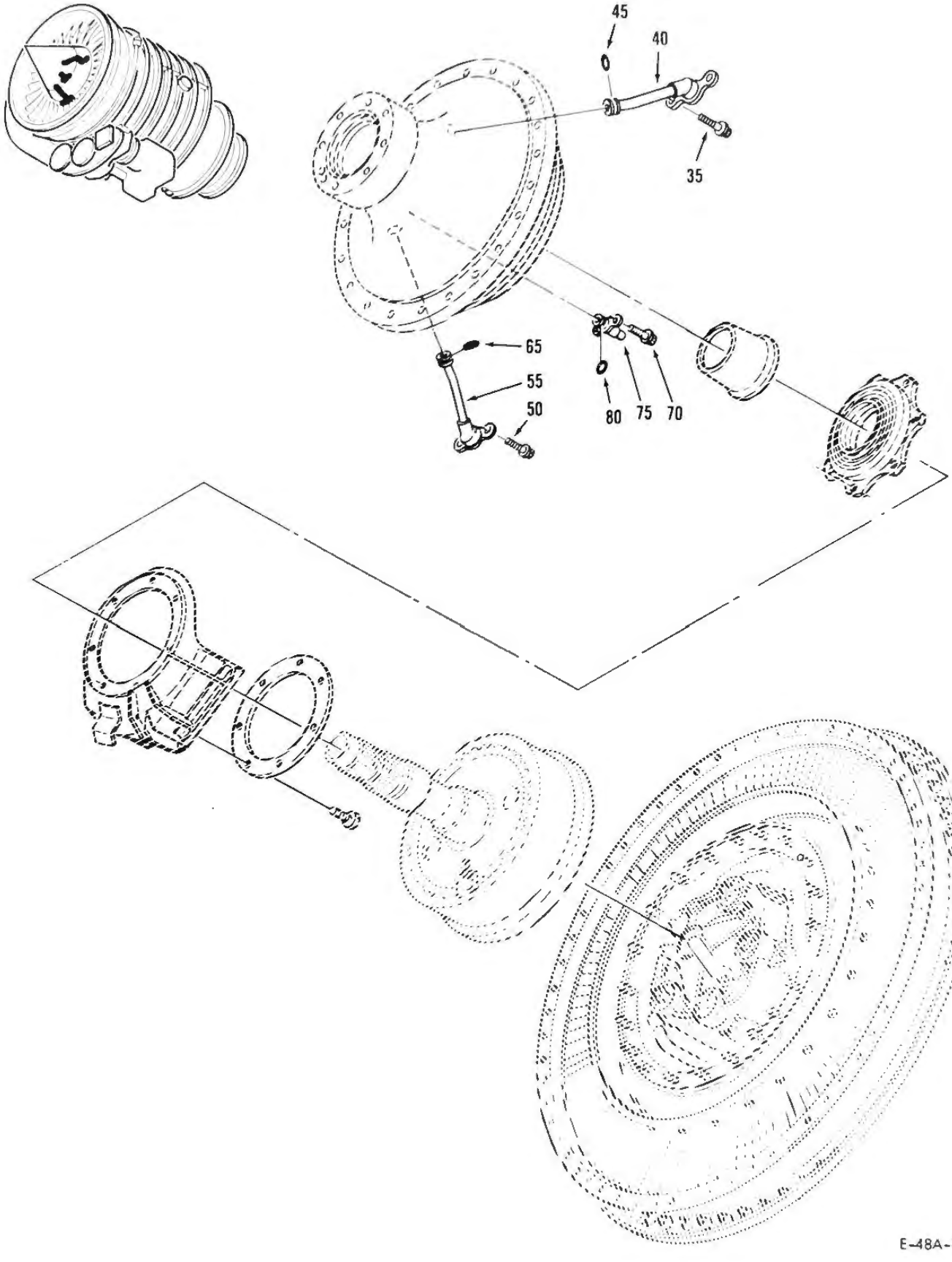
NOTE: Whenever the fan support assembly is removed from the engine, cover the oil scavenge port at the six o'clock position in the strut of the intermediate case assembly. This is to ensure that tools or hardware are not accidentally dropped onto the opening.

(5) Remove fan seal assembly and roller bearing in accordance with 72-71-01, MAINTENANCE PRACTICES.

(6) Remove fan support, deflector, and fan thrust bearing in accordance with 72-71-02, MAINTENANCE PRACTICES.

(7) Remove bolts securing oil transfer tubes to fan support housing. Remove tubes; remove packings from tubes.

(8) Remove bolts securing oil jet to fan support housing. Remove oil jet, then remove packing from oil jet.



R

R Fan Oil Transfer Tubes and Jet Installation
Figure 201

1. B. Install Fan Oil Transfer Tubes and Jet (See Figure 201)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Install new packing on oil jet, position oil jet on fan support housing and secure with bolts. Tighten bolts
R (70) to torque of 50 inch-pounds.

(2) Install new packings on oil transfer tubes, position tubes on fan support housing, and secure with bolts.
R Tighten bolts (35) to torque of 50 inch-pounds.
R Tighten bolts (50) to torque of 60 inch-pounds.

(3) Install fan support, deflector, and fan thrust bearing in accordance with 72-71-02, MAINTENANCE PRACTICES.

(4) Install fan seal assembly and roller bearing in accordance with 72-71-01, MAINTENANCE PRACTICES.

NOTE: Remove covering from oil scavenge port at the six o'clock position in the strut of the intermediate case assembly.

(5) Install fan support assembly in accordance with 72-70-06, MAINTENANCE PRACTICES.

(6) Install compressor inlet stator in accordance with 72-20-02, MAINTENANCE PRACTICES.

(7) Install fan rotor assembly in accordance with 72-70-03, MAINTENANCE PRACTICES.

R (8) Install fan spinner and spinner support installation in
R accordance with 72-70-01, MAINTENANCE PRACTICES.

KEY TO FIGURE 201

R 35. BOLT (IPC FIG. 80)
R 40. TUBE
R 45. PACKING
R 50. BOLT
R 55. TUBE
65. PACKING
70. BOLT
75. FAN BEARING OIL JET
80. PACKING

2. Inspection/Check

A. Inspect Fan Oil Transfer Tubes and Jet

(1) Inspect tubes for cracks, dents causing a crease or which reduce diameter by more than ten percent, chafing, corrosion, or internal obstruction.

(2) Inspect oil jet for cracks, distortion, or obvious damage.

(3) Replace part that does not meet inspection requirements in steps (1) and (2).

3. Cleaning/Painting

A. Clean Parts

(1) Clean all standard metallic hardware in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method 1 or 2.

(2) Clean oil tubes and oil jet in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method 12.

AIR AND OIL TRANSFER TUBES AND FITTINGS INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove Fan Seal Air Transfer Tube and Bearing Cavity Vent Tubes (See Figure 201)

(1) (Code A) Remove engine wiring harness in accordance with 72-0D-02, MAINTENANCE PRACTICES.

(2) Remove fuel heater or oil to cooler tube installation in accordance with 79-20-06, MAINTENANCE PRACTICES.

(3) Remove fuel/oil cooler installation in accordance with 79-20-07, MAINTENANCE PRACTICES.

(4) Remove tubes from oil tank to accessory drive gearbox and oil pump in accordance with 79-10-01, MAINTENANCE PRACTICES.

(5) Remove fuel and P3 sensing lines installation in accordance with 73-10-02, MAINTENANCE PRACTICES.

(6) Remove oil pump and chip detector installation in accordance with 79-20-03, MAINTENANCE PRACTICES.

(7) Remove fuel system installation in accordance with 73-20-01, MAINTENANCE PRACTICES.

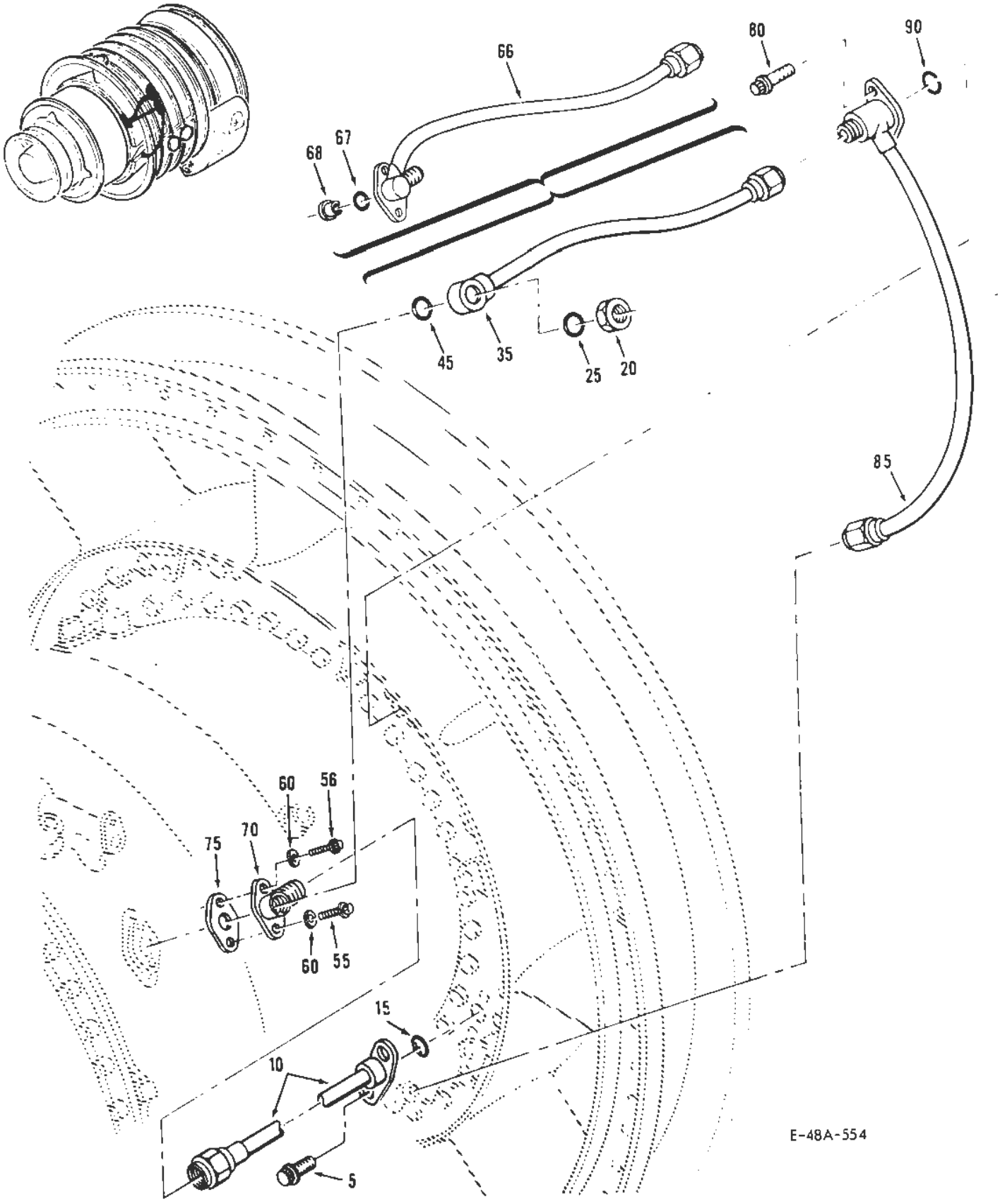
(8) Remove accessory and transfer gearbox installation in accordance with 72-60-01, MAINTENANCE PRACTICES.

(9) Remove ignition unit, lockplate, and grommet securing igniter leads to fan duct assembly or set in accordance with 74-00-01, MAINTENANCE PRACTICES.

R (10) (Code C) (Codes A, B Pre SB72-3085) Remove pneumatic tube to anti-ice pressure switch, pressure switch, and tube to solenoid controller valve in accordance with 75-10-01, MAINTENANCE PRACTICES.

(11) Remove solenoid controller valve and attached tubes in accordance with 76-10-01, MAINTENANCE PRACTICES.

(12) Remove right-side duct, oil-out tube, left-side fairing, and oil-in tube in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 201.)



Fan Seal Air Transfer Tube and Bearing Cavity Vent Tubes
Figure 201

1. A. (13) Remove botton duct rib and oil transfer tubes in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 202.)

(14) Remove hardware securing fan duct assembly or fan duct set in accordance with 72-70-05, MAINTENANCE PRACTICES.

(15) Remove bleed air ducts in accordance with 75-10-05, MAINTENANCE PRACTICES, then remove fan duct assembly or set.

(16) Remove side and bottom panels in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 203.)

(17) Remove upper and lower air/oil coolers in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 204 or 205.)

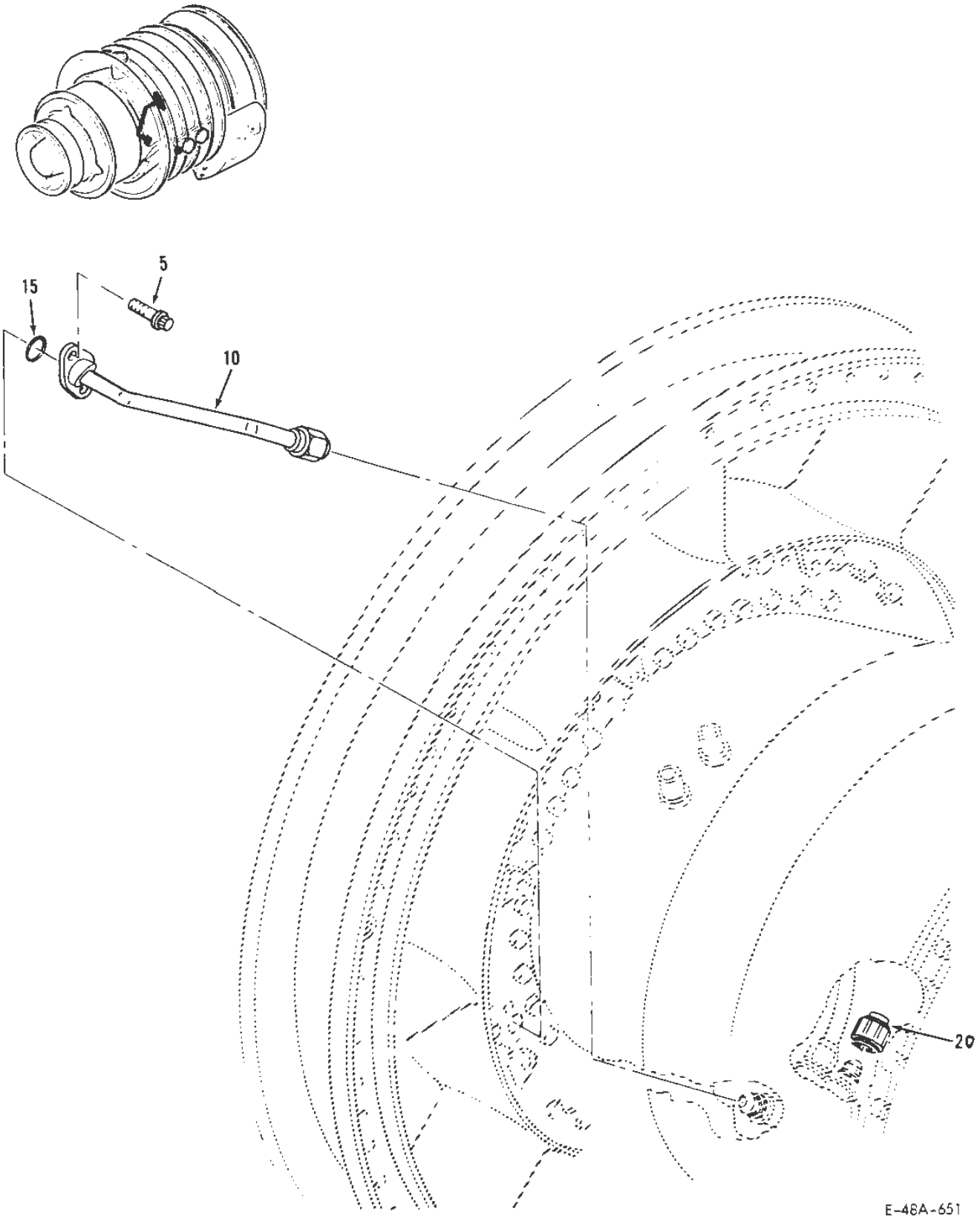
(18) (Productions engine series: 1-12 (Code A); 1-5 (Code B)) Remove nut securing bearing cavity vent tube. Remove seal and bearing cavity vent tube; remove other seal.

(19) Remove bolts securing fan seal tube assembly; remove tube. Remove packing.

(20) (Production engine series: 1-12 (Code A); 1-5 (Code B)) Remove bolts, washers, fittings, and gaskets.

KEY TO FIGURE 201

5. BOLT (IPC FIG. 111)
10. FAN SEAL TUBE ASSY
15. PACKING
20. NUT
25. SEAL
35. BEARING CAVITY VENT TUBE
45. SEAL
55. BOLT
56. BOLT
60. WASHER
66. ADAPTER
67. PACKING
68. RETAINER
70. FITTING
75. GASKET
80. BOLT
85. AIR VENT TUBE
90. PACKING



Oil Transfer Tube
Figure 202

1. A. (21) (Production engine series: 13 and Subq (Code A); 6 and Subq (Code B); 1 and Subq (Code C)) Remove bolts, washers, adapter, packing, retainer, and gasket.

(22) Remove bolts securing air vent tube; remove tube. Remove packing.

B. Remove Oil Transfer Tube (See Figure 202)

(1) Comply with paragraph 1.A, steps (1) through (17).

(2) Remove bolts securing oil transfer tube; remove tube. Remove packing.

(3) If equipped, remove tube cap.

C. Remove High Pressure Shaft Oil Transfer Tubes (See Figure 203 or 204)

(1) Comply with paragraph 1.A, steps (1) through (17).

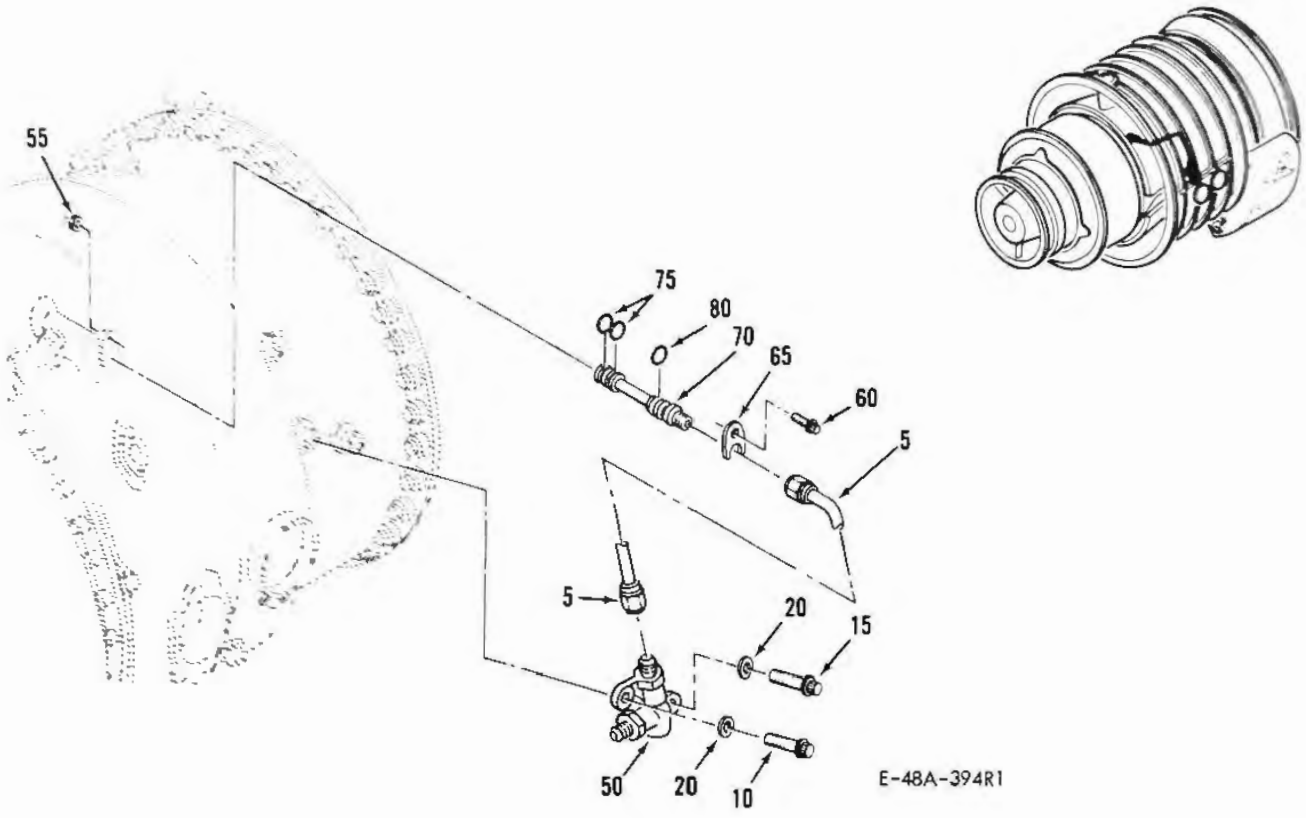
(2) Remove tube assembly. Remove bolts and washers securing adapter, then remove adapter.

(3) (Production engine series: 1-12 (Code A); 1-5 (Code B)) (See figure 203.) Remove nut and bolt; remove tube retaining lockplate. Remove transfer tube with packings. Remove packings.

(4) (Production engine series: 13 and Subq (Code A); 6 and Subq (Code B); 1 and Subq (Code C)) (See figure 204.) Remove nuts and bolts, then remove oil inlet elbow with packing. Remove packing. Remove oil transfer tube with oil jet strainer and packings. Remove oil jet strainer and packing.

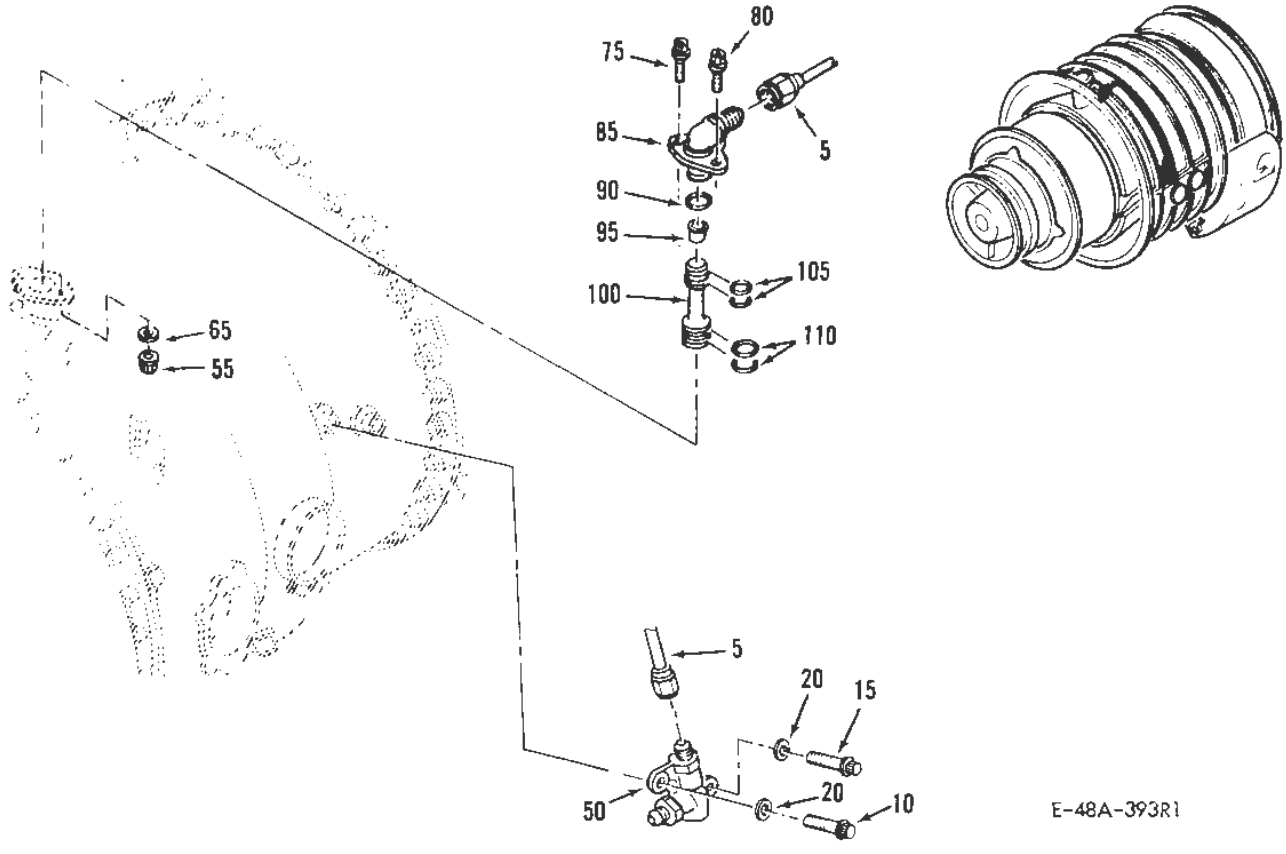
KEY TO FIGURE 202

R 5. BOLT (IPC FIG. 114)
10. OIL TRANSFER TUBE
15. PACKING
20. TUBE CAP (IF EQUIPPED)



5. TUBE ASSY (IPC FIG. 112)
10. BOLT
15. BOLT
20. WASHER
50. ADAPTER
55. NUT
60. BOLT
65. TUBE RETAINING LOCKPLATE
70. TRANSFER TUBE
75. PACKING
80. PACKING

High Pressure Shaft Oil Transfer Tubes
(Production Engine Series: 1-12 (Code A); 1-5 (Code B))
Figure 203



5.	TUBE ASSY (IPC FIG. 113)	80.	BOLT
10.	BOLT	85.	OIL INLET ELBOW
15.	BOLT	90.	PACKING
20.	WASHER	95.	OIL JET STRAINER
50.	TUBE ADAPTER	100.	OIL TRANSFER TUBE
55.	NUT	105.	PACKING
65.	WASHER	110.	PACKING
75.	BOLT		

High Pressure Shaft Oil Transfer Tubes
(Production Engines Series: 13 and Subq (Code A);
6 and Subq (Code B); 1 and Subq (Code C))
Figure 204

1. D. Install Fan Seal Air Transfer Tube and Bearing Cavity Vent Tubes (See Figure 201)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque value. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Install packing on air vent tube; install tube with packing and secure with bolts. Tighten bolts (80) to torque of 50 inch-pounds.

(2) (Production engine series: 1-12 (Code A); 1-5 (Code B)) Install gasket and fitting; secure fitting with washers and bolts. Tighten bolts (55, 56) to torque of 40 inch-pounds, and lockwire bolt (56).

(3) (Production engine series: 13 and Subq (Code A); 6 and Subq (Code B); 1 and Subq (Code C)) Install gasket, retainer, packing, and adapter; secure with washers and bolts. Tighten bolts (55, 56) to torque of 40 inch-pounds, and lockwire bolt (56).

(4) Install packing on fan seal tube assembly; install tube R with packing and secure with bolts. Tighten bolts (5) to a torque of 50 inch-pounds.

(5) (Production engine series: 1-12 (Code A); 1-5 (Code B)) Install seal, and bearing cavity vent tube; install other seal, then secure tube with nut. Tighten nut (20) to torque of 50 inch-pounds.

(6) Install upper and lower air/oil coolers in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 204 or 205.)

(7) Install side and bottom panels in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 203.)

(8) Position fan duct assembly or fan duct set on engine and install bleed air ducts in accordance with 75-10-05, MAINTENANCE PRACTICES.

(9) Install fan duct assembly or fan duct set in accordance with 72-70-05, MAINTENANCE PRACTICES.

(10) Install bottom duct rib and oil transfer tubes in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 202.)

1. D. (11) Install right-side duct, oil-out tube, left-side fairing, and oil-in tube in accordance with 79-20-09, MAINTENANCE PRACTICES. (See 79-20-09, figure 201.)

(12) Install solenoid controller valve and attaching tube assemblies in accordance with 76-10-01, MAINTENANCE PRACTICES.

R (13) (Code C) (Codes A, B Pre SB72-3085) Install anti-ice pressure switch and pneumatic tubes to pressure switch and solenoid controller valve in accordance with 75-10-01, MAINTENANCE PRACTICES.

(14) Secure igniter leads with grommet and lockplate, then install ignition unit in accordance with 74-00-01, MAINTENANCE PRACTICES.

(15) Install accessory and transfer gearbox installation in accordance with 72-60-01, MAINTENANCE PRACTICES.

(16) Install oil pump and chip detector installation in accordance with 79-20-03, MAINTENANCE PRACTICES.

(17) Install fuel system installation in accordance with 73-20-01, MAINTENANCE PRACTICES.

(18) Install fuel and P3 sensing lines installation in accordance with 73-10-02, MAINTENANCE PRACTICES.

(19) Install tubes from oil tank to accessory drive gearbox and oil pump in accordance with 79-10-01, MAINTENANCE PRACTICES.

(20) Install fuel/oil cooler installation in accordance with 79-20-07, MAINTENANCE PRACTICES.

(21) Install fuel heater or oil to cooler tube installation in accordance with 79-20-06, MAINTENANCE PRACTICES.

(22) (Code A) Install engine wiring harness in accordance with 72-00-02, MAINTENANCE PRACTICES.

E. Install Oil Transfer Tube (See Figure 202)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) Install tube cap.

(2) Install packing on oil transfer tube; install tube with packing and secure with bolts. Tighten bolts (5) to torque of 50 inch-pounds.

R 1. E. (3) Comply with paragraph 1.D, steps (6) through (22).

F. Install High Pressure Shaft Oil Transfer Tubes (See Figure 203 or 204)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque value. Add frictional drag (run-down) torque of self-locking devices to recommended values.

(1) (Production engine series: 1-12 (Code A); 1-5 (Code B)) (See figure 203.) Install packings on transfer tube; install transfer tube with packings. Secure transfer tube with retaining lockplate, bolt, and nut. Tighten nut (55) to torque of 40 inch-pounds.

(2) (Production engine series: 13 and Subq (Code A); 6 and Subq (Code B; 1 and Subq (Code C)) (See figure 204.) Install packings on oil transfer tube, then install oil jet strainer. Install oil transfer tube with packings on oil jet strainer. Install packing on oil inlet elbow; install oil inlet elbow with packing. Secure oil inlet elbow with bolts, washers, and nuts. Tighten nuts (55) to torque of 40 inch-pounds.

(3) Install adapter, then secure with bolts and washers. (Figure 203 or 204.) Tighten bolts (10, 15) to torque of 40 inch-pounds.

(4) Install tube assembly.

R (5) Comply with paragraph 1.D, steps (6) through (22).

2. Inspection/Check

A. Inspect Fan Seal Air Transfer Tube and Bearing Cavity Vent Tubes (See Figure 201)

(1) Inspect for cracks, dents causing a crease or which reduce diameter more than ten percent, chafing, corrosion, or internal obstructions.

(2) Replace part that does not meet inspection requirements.

B. Inspect Oil Transfer Tube (See Figure 202)

(1) Inspect for cracks, dents causing a crease or which reduce diameter more than ten percent, chafing, corrosion, or internal obstructions.

(2) Replace part that does not meet inspection requirement.

2. C. Inspect High Pressure Shaft Oil Transfer Tubes (See Figure 203 or 204)

(1) Inspect tubes for cracks, dents causing a crease or which reduce diameter by more than ten percent, chafing, corrosion, or internal obstructions.

(2) Inspect oil jet strainer for damaged wire mesh and broken braze joints.

(3) Inspect adapter, and if applicable, oil inlet elbow for cracks, distortion, or dents.

(4) Replace part that does not meet inspection requirements in steps (1) through (3).

3. Cleaning/Painting

A. Clean Parts

(1) Clean all standard metallic hardware in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method 1 or 2.

(2) Clean tubes, adapter, and if applicable, oil inlet elbow in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method 12.

(3) Clean oil jet strainer in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Specific Cleaning Instructions.

INDICATING - DESCRIPTION AND OPERATION

1. Oil Filter Bypass Indicator Valve

The oil filter bypass indicator valve (with integral delta pressure indicator) is located on the outside right hand side of the accessory drive gearbox and is connected in parallel with the oil filter. Should an excessive accumulation of impurities clog the oil filter to the extent that the pressure drop across the filter is excessive, the normally closed bypass valve will open, allowing oil to bypass the filter to avoid possible bearing starvation. A pop up button on the bypass valve actuates before the bypass valve opens. The bypass valve pop up button is locked in at low oil temperatures.

R

OIL FILTER BYPASS INDICATOR VALVE INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove Oil Filter Bypass Indicator Valve as Follows (See Figure 201)

(1) Remove nut and washer securing valve, then remove valve.

(2) Remove packings from valve.

B. Install Oil Filter Bypass Indicator Valve as Follows (See Figure 201)

NOTE: Refer to 70-00-00, STANDARD PRACTICES for general torque values. Add frictional drag (run-down) torque of self-locking devices to recommended values.

R Lightly coat packings for filter bypass indicator valve with
R engine lubricating oil (72-00-00, GENERAL - SERVICING, Table
R 301) and install packings on valve. Insert valve in housing
R assembly and secure with washer and nut. Tighten nut (5) to
R torque of 30 inch-pounds.

2. Inspection/Check

A. Inspect Oil Filter Bypass Indicator Valve

(1) Visually inspect valve through discharge port on side of valve to observe permanent magnet on end of piston. Magnet shall be secured to end of piston. Replace valve if magnet is broken loose.

(2) Apply force against end of piston using eraser-end of pencil or other suitable tool. Piston shall stroke to a detent and red pin on end of valve shall extend. Apply additional force and observe that piston strokes to full bypass position. Replace valve if requirements are not met.

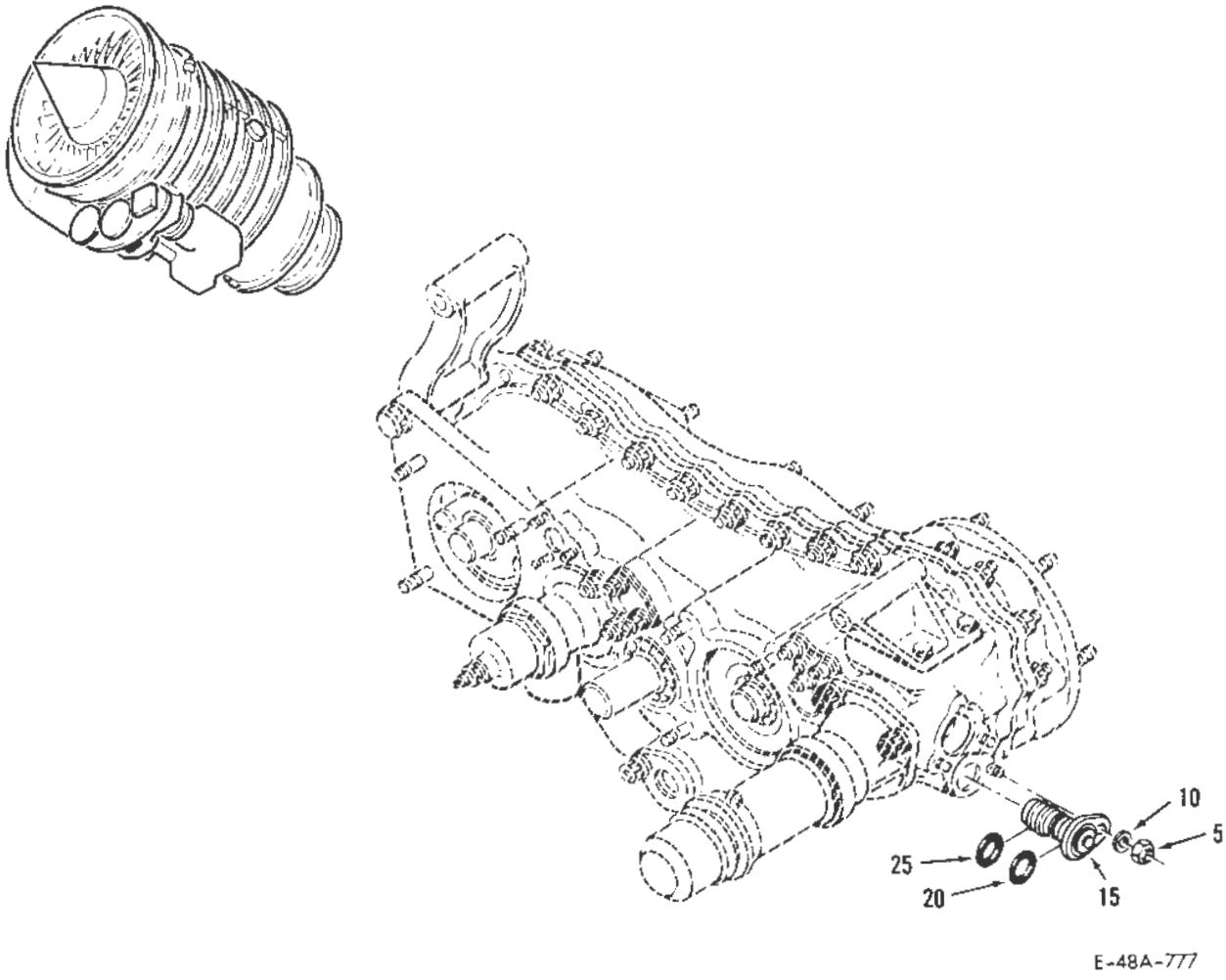
(3) Release force on piston. Apply light pressure on red pin to return pin to reset position (flush with end of valve). Replace valve if requirement is not met.

3. Cleaning/Painting

A. Clean Parts

Clean all standard metallic hardware in accordance with 72-00-00, GENERAL - CLEANING/PAINTING, Cleaning Method 1 or 2.

R



R 5. NUT (IPC FIG. 68)
R 10. WASHER
R 15. BYPASS INDICATOR VALVE
20. PACKING
25. PACKING

R Oil Filter Bypass Indicator Valve Installation
Figure 201